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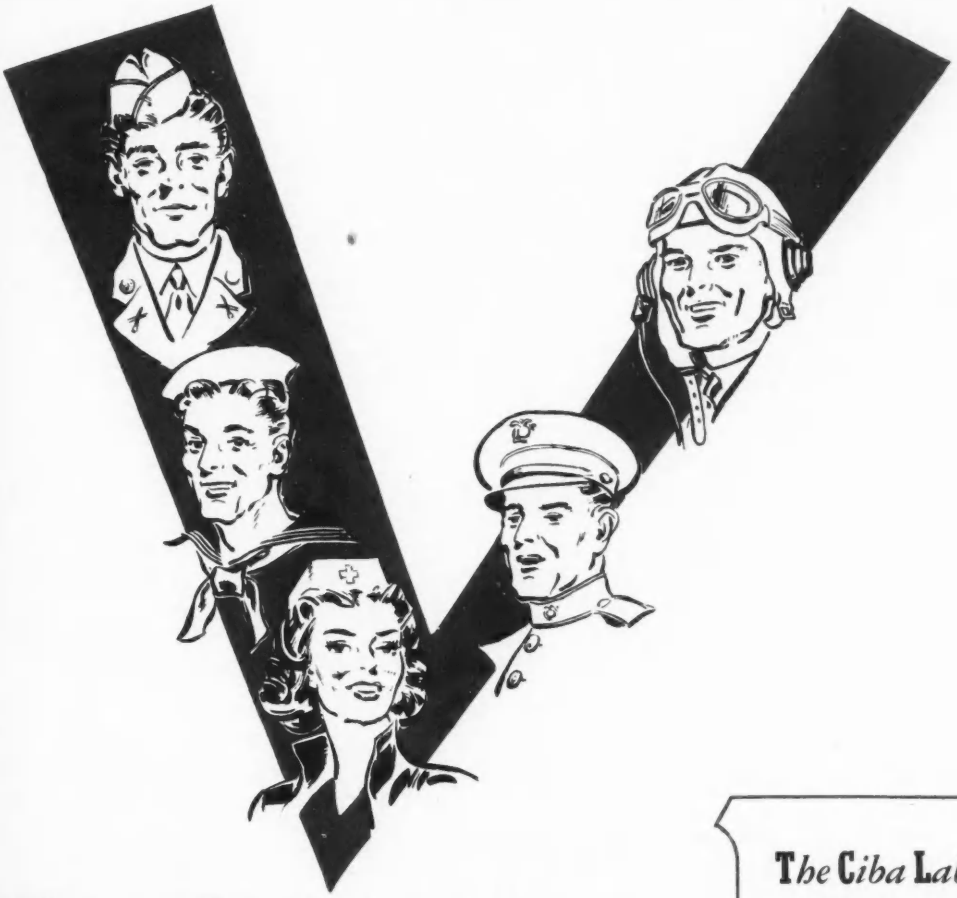

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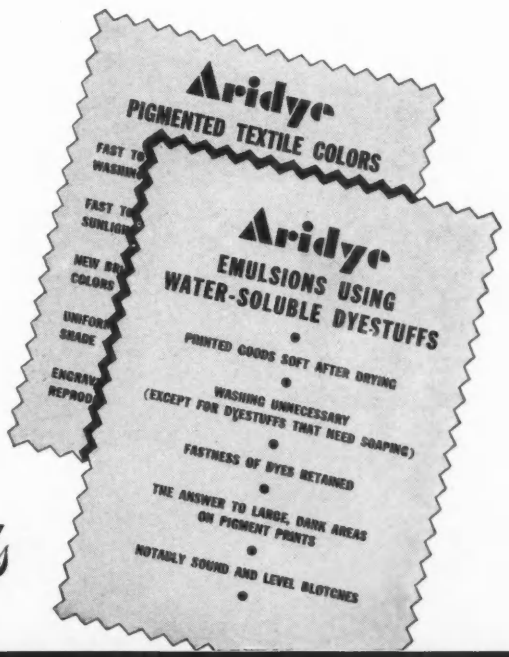

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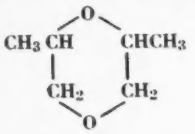

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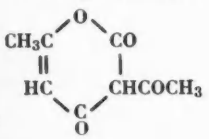

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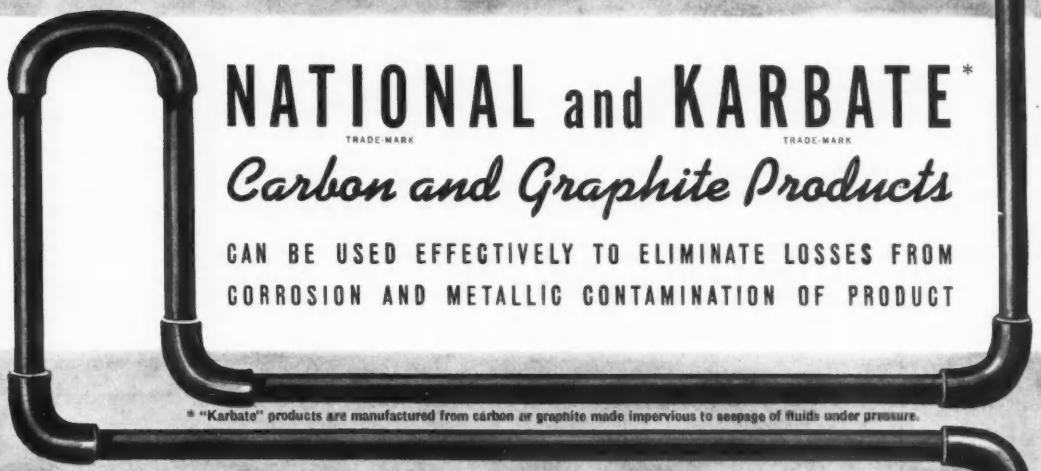

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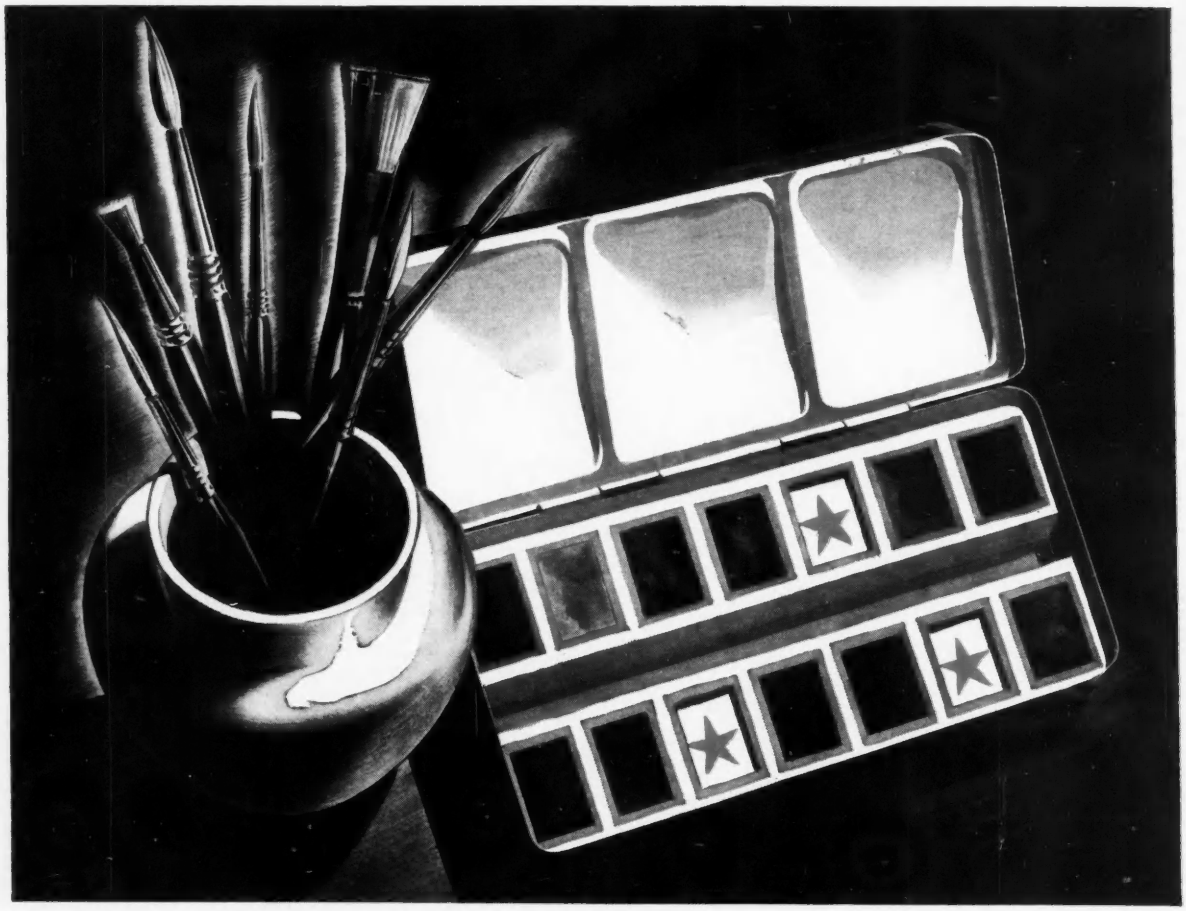

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AMERICAN
DYESTUFF REPORTER

VOLUME 31 FEBRUARY 16, 1942 NUMBER 4

Further Investigations of the Affinities of Anions of Strong Acids for WOOL PROTEIN

JACINTO STEINHARDT, CHARLES H. FUGITT, and MILTON HARRIS

ABSTRACT

The present report covers a continuation of earlier studies by Research Associates of the Textile Foundation, designed to form a basis for understanding the factors influencing the dyeing of wool. Measurements of the affinities for wool of 18 additional strong acids have now been made. On the basis of newly introduced refinements in the method of calculating affinities both the present and earlier results are computed and the affinity constants for a total of 33 different acids, several at more than one temperature, are tabulated. The assembled data indicate that there exists a fairly consistent relation between the molecular weights of strong organic acids and their affinities for the fiber. Thus, at one end of the series are the compounds of low molecular weight, which have low affinities and can be readily washed from the wool. At the other end are the acids of high molecular weight, such as the acid dyes, which are bound so tightly that they are relatively fast to washing.

I. INTRODUCTION

IT has been shown in a previous paper that the titration curves of wool and other proteins obtained with a number of strong acids are not identical but occupy very widely different positions with respect to the pH co-ordinate[16]. These wide differences have been interpreted as due to combination of protein with anions as well as with hydrogen ions, the combination with each anion being governed by its own distinct dissociation constant. It has been shown also that by making a number of simple assumptions these dissociation constants (or their reciprocals, the affinities) may be calculated from the titration data.

The existence of differences in the affinities of anions for protein has a direct bearing on dyeing theory. A serious difficulty in "chemical" theories of dyeing, which have attempted to draw a close analogy between the combination of fibers with hydrochloric acid and their combination with acid dyes, has been the lack of an explanation of why the combination of dyes is relatively fast to water and dilute alkalies while that of hydrochloric acid is not. If the equilibrium of fibers with both of these acids is considered solely in terms of an acid-base (i.e., hydrogen ion) equilibrium, one would conclude that both acids should be bound equally well. The existence of a second dissociation equilibrium involving each anion provides a basis for understanding these differences, and encourages exploitation of the many attractive features of the "chemical" theory of acid dyeing.

Experiments reported elsewhere[14] have shown that the quantitative formulation of the anion affinity concept may be applied to mixtures of acids or of acids and salts, systems which more nearly approach in complexity the dyebaths commonly employed in industry than do the simple systems involved in measurement of titration curves. Measurements of the amounts of each of the anions combined with the fiber have indicated the nature of some of the factors controlling fastness and degree of exhaust, in addition, they have suggested a consistent explanation of the part played by various widely used assistants (such as Glauber's salt) in promoting level or solid dyeing, which will be discussed elsewhere. Since it is indicated by these experiments that the relative effectiveness of such assistants is directly related to their affinities, it has appeared particularly important to determine the affinities of a still larger number of compounds of more diverse types than those previously investigated in order to establish with greater certainty the relation between affinity, size, and structure of ions. Such information, especially if it is combined with more detailed knowledge of the variation of affinity at higher temperatures, would provide a basis for selecting economically practical leveling agents having the desired range of affinities for wool.

The present paper, besides describing measurements of the affinity for wool of the anions of an additional number of strong acids, makes use of certain refinements in the methods of calculating affinity[11] which make possible a more detailed comparison of theoretical predictions with experimental data. On the basis of these refinements the data previously presented are recomputed and a recapitulation is made of the results obtained with 33 strong acids. As a result the discussion of the relation between chemical structure and affinity in this paper is based on a broader survey than was previously available.

II. EXPERIMENTAL PROCEDURE

Methods of purification of the wool, measurement of pH values, and determination of the amounts of acid combined have been described in earlier publications[12, 15, 16].

Additional details concerning the specific materials and procedures used in the present investigation are described in a more detailed version of this paper published in the Journal of Research of the National Bureau of Standards (Feb. 1942).

III. RESULTS AND DISCUSSION

1. Titration Curves

The data obtained with eighteen different acids at one or more of three different temperatures are represented graphically in Figures 1 (0°C. and 25°C.) and 2 (50°C.). With most of the acids used the data represented have been obtained by approaching equilibrium from both sides, i.e., by starting with fibers which are combined with more than their equilibrium amount of acid as well as with fibers that are initially uncombined. The "reversed" measurements are indicated by tagged circles in the figures. It is clear that the sets of data obtained in both ways are consistent with one another. This agreement constitutes proof that the anion-wool associations measured are fully reversible, and that the wool in combining with acid suffers no permanent alteration until amounts which approach 0.8 millimole per g are combined.* In addition, such agreement eliminates the possibility that the results obtained are affected by the presence of acid impurities which differ appreciably in affinity from the substance under investigation. Other indications of the reversibility of the combination with acid have already been cited. Taken as a whole, they fully justify a theoretical treatment based on equilibrium considerations[12, 16].

As in the results described earlier[16] considerable amounts in excess of 0.8 millimole appear to be bound when the most concentrated solutions of some of the acids are employed. Possible causes of this excess take-up of acid have been discussed elsewhere[16]. The discussion of the affinity to wool of each of the anions dealt with in this paper is based entirely on the position with respect to the pH coordinate of the main S-shaped portion of the titration curve. In order to fix the position of this principal portion of each set of data, an effort has been made to draw continuous curves which represent the measurements fairly rather than to draw curves deliberately congruent with one another.

The curves which lie more than one to one and one-half pH units above that of the curve for hydrochloric acid must be considered as somewhat less accurately fixed by the experiments on three counts: (1) The pH values measured are those of very poorly buffered solutions; (2) the attainment of equilibrium is difficult, although the equilibrium curve can usually be fixed within narrow limits by comparing the measurements with the results of reversal experiments; (3) the relatively long periods at high temperatures required for attainment of equilibrium with acids of high affinity result in appreciable decomposition of the wool. This effect is intensified by the fact that decomposition is brought about more rapidly by acids of high affinity. Thus the choice of temperature at which each acid was investigated was governed in part by the desire to minimize as much as possible the aggregate effect of all of these factors as well as by the desire to obtain data at more than one temperature for a few acids of representatively different affinities. Acids having affinities equal to or greater than that of naphthalene-β-sulfonic acid were measured at either 25°C. or 50°C. rather than at 0°C.

The bearing of the results on the general question of the factors influencing affinity is considered in section IV of this paper but matters of special interest concerning a few of the substances worked with are discussed individually below.

Hydrochloric acid no longer occupies an extreme position at the low affinity end of the diagram (Fig. 1) as it

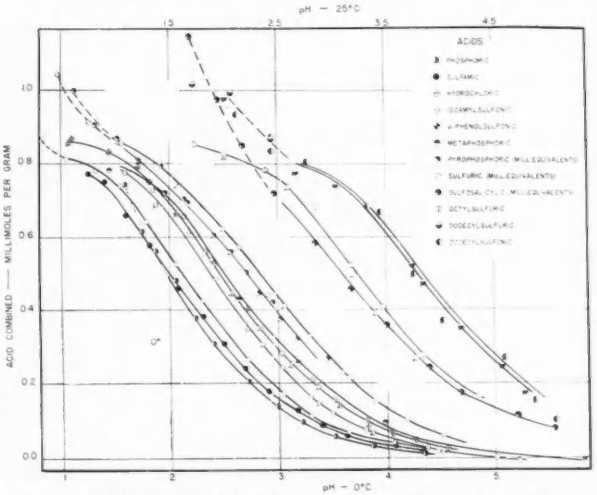

Fig. 1—Combination of wool protein with twelve different strong acids at 0° C. or 25° C. The pH scale at the bottom of the figure applies to the data obtained at 0° C. The scale at the top of the figure refers to the data obtained at 25° C. The significance of the tagged circles is described in the text.

did in the earlier paper. Two other acids give curves which indicate that their anions have affinities for wool lower than the affinity of chloride Thus, titration curves of proteins, obtained with hydrochloric acid, are also clearly affected by the specific affinity of the chloride ion for the protein, and must not be regarded as representing a limiting case governed by the hydrogen-ion dissociation equilibrium of the carboxyl groups alone.

The lowest affinity is shown by phosphoric acid, and refers to the dihydrogen phosphate ion. The data for phosphoric acid are congruent with the other curves only for amounts combined of less than 0.45 millimole per gram. This limitation is brought about by the fact that the first step in the dissociation of phosphoric acid is not complete in the range of pH below 2. The presence of appreciable

(Continued on page 97)

*Data obtained with *b*-naphthoquinone-4-sulfonic acid did not fulfil this criterion of reversibility except for small amounts combined, and are therefore omitted from this paper This exceptional behavior is consistent with the known reactivity of quinone with proteins. It is noteworthy that this dye changed color on combining with fibers, and gave a curve of combination having an appreciably lower degree of dependence on pH than did all the other acids.

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FEBRUARY 16, 1942

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Members should notify the **Secretary** immediately of all address changes

CALENDAR of Coming Events

Meeting, New York Section, February 27, 1942, Chemists' Club, New York, N. Y. Speaker: Dr. R. E. Rose, du Pont Co.

Meeting, Philadelphia Section, Hotel Philadelphian, Philadelphia, Pa., February 27, 1942.

Meeting, Northern New England Section, February 27, 1942.

Meeting, Southeastern Section, Waverly Hotel, Columbus, Ga., March 21, 1942. A round table discussion will be held.

Research Committee and Council Meetings, North Carolina State College, Raleigh, N. C., April 18, 1942.

Meeting, Piedmont Section, Sir Walter Hotel, Raleigh, N. C., April 18, 1942.

TEXTILE EDUCATION*

M. EARL HEARD

Dean, Philadelphia Textile School

THE textile industry is unique in many respects, and certainly in that it is the only industry, according to my information, that has developed a particular group of schools whose sole purpose is to train men for its own field. Since textiles are strongly interwoven with the history and progress of every age, a history of textiles will certainly give the reader considerable information about the history of man. It is perfectly natural that, textiles having been a necessity long before the machine age, the industry should have its background in the arts and crafts.

Textile education is a hybrid, yet I believe it approaches the field of engineering closer, possibly, than it touches any other group. In the early days utility was one of the principal factors in the production of textiles, and we had not as a people developed the keen sense of color appreciation that we find today in every walk of life. One has only to look at the variety of color evidenced in men's clothing to realize that at last the conservative male is accepting color in his wardrobe to a very great extent.

In the early days only the natural fibers were utilized. Today, with the technological advances in manufacturing and the many fine developments in the synthetic field, we have seen the need for additional knowledge in our textile curricula. Also, the fact that the textile industry is made up of many small plants scattered over a large part of the country creates problems of management, buying and selling that industries centralized in large units do not encounter to such an extent. With the many new developments that have been made and are still coming from the field of chemistry and technology, our industry is slowly but surely changing from a rule of thumb industry to one of scientific operation and management.

While the industry as a whole occupies a very low position with respect to the total funds expended for research in comparison with other industries, many of which are smaller and of considerably less importance to humanity, this picture is also changing and changing rapidly. The most progressive firms in the industry are developing laboratories in their own plants and a number of programs are being carried out by organizations such as the Textile Foundation, the Federal Government in the Regional Research Laboratories, and the Mellon Institute. What, then, is our textile industry going to need in the way of man power five, ten, fifteen or twenty years hence?

It is our job in the textile schools, through constant discussion and analysis of the problems of the industry today, to anticipate these demands and shape our curricula to fill the need to the best of our ability.

THE TEXTILE FOUNDATION

No man could realize and appreciate the tremendous influence for good that the Textile Foundation has had upon textile education in this country unless he had been a constant attendant at the semi-annual meetings of the textile school deans, conducted by the Foundation. Most of you are familiar, I am sure, with the work of the Textile Foundation and the source of its funds. The Foundation was organized in 1930-32.

At the conclusion of the World War, the Reparations Commission impounded the existing stocks of dyes in Germany and apportioned certain quantities of such stocks to each of the Allied and Associated Powers, as reparations. Fifteen hundred metric tons was the share apportioned to the United States, where the dyes were badly needed. However, the State Department refused to accept any reparations from Germany, but in order to make the dyes available to industry, allowed individual firms to order dyestuffs from the Reparations Commission at an agreed price. Three hundred tons were so ordered. The State Department then asked the Textile Alliance, a war time non-profit organization, to underwrite the remaining twelve hundred tons, with the provision that any resulting surplus funds would be turned in to the United States Treasury for education and research.

A surplus of nearly two million dollars accrued to the Textile Alliance, and as these funds had not resulted from government operations it was decided to create an organization to administer this sum for the benefit of the textile industry. Thus, the Congress created the Textile Foundation. The act creating the Foundation—71st Congress (H. R. 9557)—was signed by President Hoover on June 30, 1930.

It was organized for scientific and economic research for the benefit and development of the textile industry, its allied branches, and including that of production of raw materials. Franklin W. Hobbs, President of Arlington Mills, Lawrence, Massachusetts, was appointed Chairman of the Board of Directors by President Hoover, and since that time has been twice re-appointed by President Roosevelt. Stuart W. Cramer was the first treasurer, and Cramer gave his services untiringly until his passing about a year ago. Henry B. Thompson of the United States Finishing Company served on the Board of Directors until shortly before his death. Frank D. Cheney, one of the original directors, is still serving. Edward Pickard

*Presented at meeting, Philadelphia Section, January 9, 1942.

is Secretary and Treasurer, and has rendered a magnificent service since the inception of the Board. Donald Comer of Avondale Mills, Alabama, is now on the Board of Directors. The current Secretary of Agriculture and Secretary of Commerce are Directors of the Foundation.

During the years from 1932 to 1938, the Foundation employed about forty research fellows and scholars, working in the various colleges and universities, on research problems in textiles. Laboratories of the following institutions participated: Massachusetts Institute of Technology, Harvard, Yale University, Princeton University, Lehigh University, Cornell University, University of Illinois, University of North Carolina, North Carolina State College, Clemson College, Georgia Institute of Technology, Alabama Polytechnic Institute, Dickinson College, University of London and Manchester Institute.

In 1938 the Directors of the Foundation decided that the program that had been in operation for the past six years needed more effective co-ordination as the plan of scattered and oftentimes unrelated research projects in various colleges and universities was not conducive to the best results. A study of the problem led to the formation of the Scientific Advisory Committee for The Textile Foundation.

The personnel of this committee consists of Dr. Robert E. Rose, Chairman, E. I. du Pont de Nemours & Co., Inc.; Dr. Warren E. Emley, Head of the Fiber Division at the Bureau of Standards; Dr. Harold DeWitt Smith, A. M. Tenney Associates; Dr. Hugh Scott Taylor, Head of the Chemistry Department, Princeton University; Alban Eavenson, Eavenson & Levering and member of the Instruction Committee of the Board of the Philadelphia Textile School; Jesse Jones, Secretary of Commerce, and Dr. R. Y. Winters, representing the U. S. Department of Agriculture. These men took the job on a five year basis and prepared a research program that culminated in centralizing the fundamental research program of the Foundation at the Bureau of Standards under the direction of Dr. Milton Harris and an able staff of scientists. The objective of this group is to obtain fundamental chemical and physical information on textile fibers to form the necessary background for both the applied and technical research so vitally needed in the industry. The Scientific Advisory Committee is responsible for the major expenditures of the Foundation and in three short years the wisdom of such a program is being proven by the results of the staff. These busy men, by giving of their time and energy have made a contribution to the textile industry that is beyond imagination and calculation. As results come out of this research group in the years to come let us hail a group of men who had the vision and the courage to size up the problem and start work at the grass roots.

The active research projects now under way are as follows: Modification of the Chemical Structure of Wool; Biological Properties of Wool; Degradation of Cellulosic Fibers by Oxidizing Agents; Combination of Textile Fibers with Acids, Bases, and Salts; Physical Properties of Cellulose Acetate as Related to the Size of its Molecular Constituents; Mechanical Properties of Textile Fibers in Relation to Chemical Structure; and The Structures of Textile Fibers as Revealed by the Microscope.

There are four men working at the Massachusetts Institute of Technology. One man is doing mill research problems in the South. For nine years research in textile waste treatment and recovery was carried on under Dr. Baity and Dr. Cameron at the University of North Carolina.

The results of these researches were written and published without charge. In the field of Economics, studies were made by the Wharton School of Commerce and Finance, of the University of Pennsylvania, on Integration and Inventories in textile industries: by Cherington on Commercial Problems of the Woolen Industry; by the Harvard Business School on Cotton, Silk and Rayon Merchandising Studies. The Wharton School has prepared, and the Textile Foundation has published four textbooks on Textile Economics. Dean Willis of Clemson College as Chairman of a committee of the textile school deans, has prepared eight books on cotton processes of cotton manufacture. In the field of textile education, a survey was made by Dr. Frederick M. Feiker, whose services have been continued since 1932. Dr. Feiker's study is such an interesting example of educational research in our field that it deserves closer examination.

In 1932 the Advisory Committee, consisting of Dr. Karl T. Compton, President, Massachusetts Institute of Technology; Dr. E. C. Brooks, Vice President, University of North Carolina; and Dean Robert E. Doherty, School of Engineering, Yale University, selected Dr. Frederick M. Feiker, a man of outstanding ability in the engineering field, to undertake a survey regarding textile education. This survey, covering a period of seven or eight months, is the most complete and thorough program of its kind ever undertaken, with respect to textile education. It was published by the Foundation in February, 1934, and copies are still available if you have not had the opportunity to read the report. Out of this survey by Dr. Feiker came the semi-annual meetings of the textile school deans which have been held continuously since that time. Dr. Feiker acts as co-ordinator and chairman of the meetings, with the able assistance of Mr. Edward Pickard, and through these gatherings the textile school deans have come to know each other and exchange ideas and discuss many problems of mutual interest in the field of textile education.

TEXTILE SCHOOLS

You are all familiar with the fact that we have five textile schools in the East and five in the South. The Lowell Textile Institute was open for instruction on February 1, 1897. Charles Eames is the president of this institution. Today it offers four-year courses in Textile Engineering and Chemistry and Textile Coloring, leading

to the degree of Bachelor of Textile Engineering and Bachelor of Textile Chemistry. This institution also offers three-year diploma courses in Cotton Manufacture, Wool Manufacture, and Textile Design. In 1935 the institution received authority to confer a Master of Science degree in Textile Chemistry, and a Master of Science degree in Textile Engineering.

The New Bedford Textile School began its operation in the Fall of 1899. George Walker is the principal of this institution. It offers three year courses in General Cotton Manufacture; Chemistry, Dyeing and Finishing; Designing; Carding and Spinning; and Knit Goods Manufacture.

The Bradford Durfee Textile School at Fall River, Massachusetts, was incorporated in 1899 and was open for students in March 1904. Henry W. Nichols is principal of this institution. The courses are confined to cotton manufacturing and closely allied subjects. It offers a three-year General Cotton Manufacturing Course, a two-year Chemistry and Dyeing Course, and a two-year Engineering Course.

Originally the three institutions of Massachusetts—Lowell Textile Institute, New Bedford Textile School, and Bradford Durfee Textile School—were semi-private schools, but they are now State supported. Their property is owned by the State of Massachusetts and their officers and Boards of Trustees officiate under the authority of the Commissioner of Education of Massachusetts. However, each of the municipalities in which these schools are located makes some contribution towards the operation of the school.

The Textile Department at the Rhode Island School of Design is under the direction of Dean William D. Fales, Head of the Textiles and Clothing Department. This institution was started in 1903, and is a most interesting educational institution. The Rhode Island School of Design owes it origin to the Centennial Exposition of 1876 and began its career in the Fall of 1878. The records of the school indicate that as early as 1889 instruction in textiles was being considered; however, it was not until 1903 that a textile department was actually started. The school was located in Memorial Hall, a building which was formerly the Central Congregational Church. It was refitted and equipped for school work by Jesse H. Metcalf, in memory of his wife. In 1912 an act was introduced into the State Legislature to permit the building of a Textile School, and in 1915, the Metcalf Memorial Building was dedicated. This building is today the present home of the Textile School.

At the Rhode Island Textile School, practically all of the important fields of design are covered with excellent departments. The department of textiles and clothing offers a four-year course leading to a Bachelor of Textile Engineering degree, a four-year diploma course in textile designing, a three-year certificate course in wool manufacture, and a three-year certificate course in cotton manufacture.

The motive for establishing the Textile School at Philadelphia grew out of a desire to promote the manufacture of yarns and fabrics which would compete in beauty and style with the textile exhibit sent from France to the Philadelphia Centennial Exposition in 1876. Inspired by this exhibit, the textile manufacturers of Philadelphia organized the Philadelphia Manufacturers Association in 1880 to see what could be done to promote the textile industry in that city.. The leader of this movement was Theodore C. Search. Dr. E. W. France became associated with Mr. Search almost from the start and served as Director of the Philadelphia Textile School for fifty-six years until his retirement in June 1940. Certainly no man could possibly have done a finer job for textile education than did Dr. France during the years in which he directed the activities of the Philadelphia Textile School. The Philadelphia Textile School is unique in that it is a private non-profit institution. The corporate family is the Philadelphia Museum of Art, made up of three museums and two schools. The two schools—the School of Industrial Art and the Philadelphia Textile School—are located at Broad and Pine Streets in the city of Philadelphia. We offer a four year textile course leading to a Bachelor of Science degree in Textiles, a four year Chemistry, Dyeing and Printing course leading to a Bachelor of Science decree, and a three year course in textile manufacture, a three year course in chemistry, dyeing and printing, and a two year rayon and silk course.

There are five textile schools in the South and Southwest, and the first of these institutions to be organized was the textile school at the South Carolina A. & M. College, known as Clemson College. This school was organized in 1898, and Dean H. H. Willis is head of the textile school in that institution. Clemson offers a four year course in Textile Engineering, Textile Chemistry and Dyeing, and Weaving and Designing, each of which lead to a Bachelor of Science degree.

In 1899 the textile school was completed at North Carolina State A. & M. College at Raleigh, N. C. Dean Thomas Nelson is head of the textile school at this institution. N. C. State offers four year courses in Textile Manufacture, Textile Chemistry and Dyeing, Yarn Manufacture, Textile Management and in Weaving and Designing. Upon completion of any of these four year courses, a Bachelor of Science degree in Textiles is conferred. North Carolina State also offers a degree of Master of Science in Textiles for satisfactory completion of one year of graduate study in residence. The professional degree of Master of Textiles may be conferred upon graduates of the Textile School after five years of professional practice in charge of important work and upon the acceptance of a satisfactory thesis.

The A. French Textile School at the Georgia School of Technology, was established in 1897, and Professor C. A. Jones is head of the textile work at this institution. Georgia Tech offers four year courses leading to a Bach-

elor of Science degree in Textile Engineering—the curricula having various options in the field of textiles. The co-operative plan is also offered. Graduate work leading to a Master of Science degree in textiles is available and the professional Textile Engineering degree, similar to that at N. C. State.

In 1901, the trustees of the Mississippi State A. & M. College organized a textile school; however, this work was discontinued after a few years. By invitation of the legislature of the State of Texas, D. A. Tompkins, an engineer and builder of cotton mills in the south, who was instrumental in the development of Clemson College, N. C. State and Mississippi State College, presented his ideas for a textile school in Texas, at the Texas A. & M. College.

The department of Textile Engineering was established in 1905; however, instruction in this field was discontinued several years ago at this school.

The enterprise and vision of another and more recent believer in textile education, the president of the Texas Power and Light Company, John W. Carpenter, of Dallas, Texas, was responsible for the establishment of the textile engineering department at Texas Tech, Lubbock, Texas. C. M. Stanley, Jr., is head of the textile engineering department and Texas Tech offers a four year course in Textile Engineering leading to a Bachelor of Science degree, with three options—a four year course in weaving and designing; a four year chemistry and dyeing course; and a four year textile engineering course. The school also offers a professional engineering degree similar to that offered by most engineering schools.

The latest textile school is that of the Alabama Polytechnic Institute at Auburn, Alabama, where buildings and equipment were erected and installed in 1929 and 1930. Professor E. W. Camp is head of the textile department and four year courses in Textile Manufacturing, textile design, textile chemistry and dyeing, and textile administration lead to a degree of Bachelor of Science.

It is most interesting to study and analyze the various influences that have affected textile education in this country since the inauguration of the textile schools referred to above. Dr. France studied abroad and had experience as a practical manufacturer before organizing the Philadelphia school, and his keenness for textile design has made itself felt in the reputation and influence of the Philadelphia school in that respect. Lowell Textile Institute had its beginnings in the foresight of James Smith, a secretary of the Lowell Board of Trade and a promoter of the textile arts. Mr. Smith consulted with Mr. Search and Dr. France at the start of his plan, and a fabric show was held in Lowell with the cooperation of the Philadelphia men to emphasize the value of design and quality in textile fabrics. The enterprise of one man, James Smith, is therefore found directly or indirectly reflected in all three of the textile schools of Massachusetts, and in the correspondence school courses in textiles which are still given by the International Correspondence School of Scranton, Pa.

President Charles H. Eames of Lowell is a graduate of M.I.T., and quite naturally his background and training would bring engineering to the front in the work of Lowell.

D. A. Tompkins, an engineer and builder of cotton mills in the South, was educated and trained in technical schools, mills and machine shops in the east. His influence was an important factor in the development of Clemson, of N. C. State, of the school in Mississippi and of the school at Texas A. & M.

Professor E. W. Camp, head of the textile school at Auburn is a Georgia Tech graduate, and taught in that institution for twenty odd years. He was then called to Texas Tech to inaugurate the new textile department there. After serving for four years as head of the textile department there, he was called to Auburn to organize a textile department at Auburn. Carl D. Brandt, a Lowell Textile graduate followed Mr. Camp as head of the school at Lubbock and served for four years. The writer served six years on the textile staff under Mr. Camp and Mr. Brandt and then served for six years as head of the school. Roland Lee, Jr., a Clemson graduate, was head of the school for one year and the present head, C. M. Stanley, Jr., is an Auburn graduate.

We therefore see the influence of one school upon another. This factor makes itself felt on the staff as well as among the heads of the schools, since younger members of the teaching staffs are frequently graduates of other schools. This is a healthy diffusion, in my opinion, as it is all too easy for an institution to become the victim of inbreeding.

Textile education at the high school and trade school level is also receiving attention all over the country. A fine illustration of the increased interest in our field is to be found in New York City at the Straubenmueller High School and the Central High School for Needle Trades, which have splendid textile departments with adequate equipment. Another good example of secondary education in textiles is the Parker School District in South Carolina. The legislature of North Carolina recently approved an act for the establishment of a textile trade school in the Gastonia area.

We frequently receive requests from high schools scattered all over the country for information on the establishment of textile courses. In my opinion, this is highly important as only a small percentage of high school graduates attend college and an infinitely small percentage of this number attend textile schools. This fall there are only 1,635 students enrolled in the ten textile schools of the country.

The five textile schools in the east all operate large evening schools open to men in the industry. This work, to reach the maximum number of people, must of necessity be given below college level; however, the service ren-

dered by these evening schools is a magnificent one. The enrollment in evening classes in the five textile schools in the east this fall is approximately 4,400 students.

A number of progressive concerns have conducted textile evening schools of their own with fine success. Practically all of these companies utilize the textile school graduates with the company together with the local school facilities. The work done in Georgia by the Bibb Mfg. Co. and the State Department of Industrial Education; the textile classes in the Chattachoochee Valley offered by the West Point Mfg. Co.; the textile school operated by Callaway Mills of LaGrange, Ga.; and the textile classes offered by the Marshall Field mills at Spray and Leakesville, N. C., are illustrations of a far-sighted policy on the part of management to train men within the ranks for more responsibility.

TRAINING MEN FOR THE INDUSTRY

As we study the problem of training men for the textile industry in our respective schools, with a sincere desire to see our graduates go out so well equipped that they will be able to meet the demands of the industry, we recognize that there are many things that we would like to have the student know. However, we are immediately faced with the fact that we have only four years to do this job, and that our raw material is composed of young men coming to us from various sections of the country with good, bad or indifferent high school preparation, with varied personalities and philosophy, with inhibitions, often with dislike of discipline and lack of respect for authority.

We must endeavor to give these students what we can to make them useful citizens in this industry, for the good of themselves and for the good of society. Unlike the average college or university, the textile school is a highly specialized technical school, and most of you realize all too well that almost any phase of this great industry will require a lifetime to master. Therefore, if we ground this student so thoroughly in fundamentals that no matter what his problem might be, he can always go back to basic facts, we believe that we will be accomplishing our objective in a manner acceptable to you. The graduate who has received a sound thorough training in English, mathematics, physics, chemistry, mechanics and raw materials, and upon these foundation stones has erected the various structures of yarn manufacture, weave formation, fabric analysis, color and its application weaving, testing, microscopy, finishing, economics, costing, marketing and industrial relations; such a graduate will indeed have a preparation that should fit him for usefulness in the textile industry.

Few students in college know definitely what field of work they wish to enter after graduation. Recognizing this fact, we believe that a good course in fundamentals is the proper training for the textile student. However, we must not only give him short range ammunition for the immediate job he enters after graduation, but we must give him long range ammunition, in the form of training in management, for that time ten to fifteen years hence when he will have proven to you that he is capable of accepting some of your responsibilities.

I have been speaking generally of textile education and trying to paint a picture that would bring us up to date. Of necessity I shall have to discuss our conception of the future at Philadelphia and when I refer to specific courses and projects quite naturally it will be our plan of attack. However, I believe the same general plan will hold true for many of the other textile schools.

We are placing greater emphasis than ever before upon a study of the raw materials of the industry. The student must be familiar with sources, methods of purchasing, price trends and values, grading and classifications, of all fibers. With the many changes that have occurred and are still to come in the varied use of fibers within the individual mill, our students today should know cotton carding, wool carding, worsted carding, and blends of fibers on each of these systems. We do not want a cotton course, nor a wool course, nor a worsted course, but a well-rounded program embracing all of the raw materials used by the industry today, as far as it is possible to cover the field in the textile school. This same thought should be carried right on through the remaining processes of yarn manufacture, weaving, dyeing and finishing. One of the fine things about our industry today is that the cotton mill, in endeavoring to run rayon, wool and other fibers on cotton machinery, is beginning to appreciate, for the first time, that other branches of the industry have their fine points and that something can be learned from their methods of processing. The same thing holds true in the woolen and worsted field, and I believe that the interchange of ideas and information going on throughout the entire industry today will be of great value.

The deans of the textile schools are constantly seeking new ideas, advice and counsel from the leaders of the industry, and at our semi-annual meetings we have had the opportunity to invite some of the outstanding personalities in textiles to address our group. To those men who have contributed to these meetings, we owe our everlasting gratitude. These gatherings have had a double effect in that these men have gone away from the Dean's meetings with much more knowledge of the textile schools and their programs than they formerly had.

The Textile Foundation has done a splendid job in the development of economics and management texts for the textile schools. In all of the work done with and for the schools the Foundation has never in the slightest degree assumed a dictatorial attitude, nor has it adopted the position that textile education should be standardized. The various books developed have not been presented as a last word in that field, but merely as a suggestion of the approach that might be taken. Prior to the inception of this program those textile schools that were departments of state institutions naturally had their economics taught

by some member of the economics department of that particular school. Every textile school had practically the same difficulty in that the industry was very little understood by these economic teachers, and the inability to discuss the problems of the textile industry were primarily due to lack of information. Therefore, at the request of the deans, the Foundation arranged a ten-day seminar in New York City, and one representative from the economics department of each school was privileged to attend this session. This program has had an amazing effect in that these gentlemen were filled so full of the textile industry during that ten-day period, they were literally bursting at the seams. The program was carried further by the studies made by the Wharton School of the University of Pennsylvania, and by the development of four texts published under the following titles: "Problems of the Textile Industry," "Management," "Marketing," and "Textile Costing." These books are used as textbooks in practically all of the textile schools, and if they are not on your shelf, you should order a set from the Textile Foundation today. Prior to the inception of this program a number of the schools were offering work in economics and some work in cost accounting; however, after discussing the matter with each of the deans, I can say that the work in this field has been tremendously improved during the last few years. Also, studies have been made concerning various textile courses, and a number of books have been published on cotton manufacturing through a committee headed by Dean Willis of Clemson which have been of considerable value in enabling us to re-evaluate and revise many of our textile courses. The wholesome effect of the work of the Foundation has been to broaden the curricula of the various textile schools and to stimulate our thinking, with the result that we are able to attract a higher type of student. Certainly these improved methods will be reflected in the type of graduates that go out of the schools in the future.

We have the opinion that the textile student today should have a grasp of the mill as a complete business enterprise. We firmly believe that an interneship of several years is the best procedure for a graduate to pursue immediately after leaving school, and while he is working through the mill in various departments, if he has had some training in economics, management, cost accounting and marketing, he will view the picture as a whole and relate each department and process properly to one another. He may not and probably should not be called upon until he is mature enough, to express his views; however, I think this type of graduate will make a better man in your plant and will not become discouraged as quickly as the man without similar training. With this thought in mind, one of our projects in the senior year is a mill organization course in which the student is given the following production problem to solve to produce a certain range of fabrics which he may select, in a certain quantity per week; he is to plan a mill to make the quantity and quality of fabrics desired. First involved in this process is a little economic geography, relative to distribution, climate, water supply, power, transportation and available labor. Next, a study of the best available equipment will necessitate a review and research of the work he has had in various courses in the past; then he studies the best type of mill building, and the location and balancing of machinery. The layout and routing of the work through the plant and many other factors involved require the student to put together what may have been a jig-saw puzzle to him during the years just passed. If he has decided what branch of the industry he wants to enter, this problem will afford him an opportunity to dig into that part of the industry and accumulate up-to-the-minute information and review knowledge that he may have partly forgotten.

In our work at Philadelphia we have our economics and management work flowing through the entire four years, beginning with a course in economic history of the United States, which is in reality an industrial history with emphasis being placed on the part textiles have had down through the years. In his sophomore year the student has a course in business administration, followed by a course in textile economics in the second semester. In the junior year he has a course in production control and management, together with a thorough course in textile costing. In the senior year he receives a course in marketing and a course in industrial psychology.

We must also give the student a sound foundation in science to enable him to evaluate the work coming out of the research laboratories of the country, and also to stimulate his personal interest in research. All of the textile schools are interested in research in this connection, and I would like to quote the comment of Dr. Vannevar Bush on the front cover of the October issue of "Textile Research"—"There is no field in which there is a greater opportunity for accomplishment than that of textiles. The key to accomplishment is research. It need not be complex, in order to be useful, but it certainly should be intelligent." It is an inspiration to have such a clean, clear-cut statement concerning the textile industry from a man of this calibre. I feel certain that this association recognizes the truth in this statement that there is no field in which there is a greater opportunity for accomplishment than that of textiles.

While we recognize that the textile school is a place for fundamental instruction, we also see very clearly that in our industry it is highly essential that we have a constant ebb and flow of visiting speakers from the industry coming into the school, and students and faculty members going out from the school on plant visits and projects. We have set up a definite program concerning visiting speakers and plant visits by various classes at our School, and we are extremely fortunate in the strategic location of Philadelphia, with regards to a most diversified textile industry.

We have no summer school at our institution and our

entire staff is employed on a twelve months basis with thirty days' vacation. During the two months of summer when we have no school, our faculty are out in the trade visiting mills, machinery manufacturers, and every type of organization that we feel can contribute something to our program for the coming year. The School has also adopted the policy of adequate representation from the faculty in every textile society, and the effects of this program are already becoming evident.

Industry of necessity travels at such a pace today that it is extremely difficult, if not almost impossible, for an educational institution to keep abreast of the times. Certainly the textile schools, and I believe that I can speak as a representative of this group, are not blessed with too much money for the work they would like to do. In many instances it is not money that is needed. Your advice and counsel, your moral support will serve to provide a powerful stimulus and encouragement to the faculties of the various schools, and will be received with open arms.

We need to do some straight thinking on the induction of textile graduates into the industry. We have a few instances of progressive mills who have a well-designed policy of employing graduates from various textile schools each year and putting them through a training program comparable to the interneship I referred to a moment ago. However, these firms are all too few.

First, to get better graduates from the textile schools, you should encourage the finest type of young man to interest himself in a textile education. Then set up a number of jobs in your plant for sophomores and juniors for summer work. This program will enable the boy to get somewhat familiar with your company and to earn a few dollars during the summer months. Most important of all, it will enable you to size up and determine whether or not you think he is the type of man that will fit into your organization. How much better it would be for your firm to spend a few hundred dollars on a trial period for a young man during the summer months, instead of coming into a textile school and employing a graduate cold, only to find out a year or two later that he is a mis-fit. At the end of the summer you could send a confidential report to the textile school dean concerned, relative to your findings in regard to this man, and we could then attempt to strengthen his weak points and also point him specifically for your phase of the industry. We must get away from the old policy of shoving a graduate into a plant and trying to break his spirit on the theory that if you could not kill him he must be a good man. Other engineering professions certainly do not approach the problem from this viewpoint. It is, of course, absolutely necessary for the textile school graduate to work his way through the mill, and when I say work, I mean work. After he has completed the time required in a certain department, you can request a report or a study of the process and machinery in that particular area from him, and encourage him to begin to use the training that he has received, in order that his development will continue along all fronts. I think each of the deans will agree that it is a mistake to promote a man too rapidly, and we recognize that usually the first promotion a man receives in a textile plant is one in which he is placed in charge of a group of people. This simply means that the man must have proper seasoning, and the plant superintendent wants to be certain that the man has his feet on the ground and will be able to handle his help as well as his machinery and his fibers. If you buy a piece of machinery from one of the textile machinery concerns, you naturally want all the information available on how you can get the maximum use from that piece of equipment. We believe that we could be useful in suggesting ways in which a textile graduate can adjust and acclimate himself to the tempo of plant production. If we sit down together around the conference table, I am certain that suggestions from industry will be welcome to the schools, and that together we might develop plans whereby the product of the schools would become more valuable to the industry.

The extension of graduate instruction in the various schools has presented difficulties. Many of the older men on the staffs of these schools have never had advanced training and such courses as they offer must suffer certain limitations. These men usually have heavy teaching schedules and frequently do consulting work on the side. They cannot be expected to undertake advanced studies in mathematics, physics and chemistry in their meagre spare time. It would therefore appear best to turn much of the post-graduate training over to the younger and more highly trained men.

As we incorporate more basic science into our textile curricula we will be able to graduate men who are certainly going to be needed to evaluate the results of research that is coming from various organizations and convert it into practical usefulness in the plant. In the next five or ten years we shall see much improvement in the graduate instruction in the textile field, in my opinion.

I believe that it is important that we learn as much about our new students as quickly as possible in their freshman year, in order that we may set up the necessary procedure to correct any weaknesses and guide the student into the course for which he may be best adapted. With this thought in mind we have made a study of the various methods of testing, and we are trying to select those tests that we feel will give us some indication of the student's ability in our field. For example, we feel that mechanical aptitude is important. We would also like to know something about the man's personality; his speed of reading, his vocabulary and comprehension are also rather significant. You will appreciate the fact that aptitude testing is only an indication and is not positive proof of any ability or lack of ability; however, it is extremely interesting to bring up a record of tests and then compare the performance of the in-

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Processing Products for REPLACEMENT MATERIALS to be Used in the Manufacture of Silk Hose*

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SELDOM has any industry been confronted with as sudden a change in manufacturing methods as that recently experienced by the full fashioned hosiery manufacturer. The Government order prohibiting the use of further quantities of silk for hosiery manufacture placed the knitter in the position of immediately finding other materials to take its place.

During the past two years, the hosiery industry experienced the introduction of nylon, which in many respects caused considerable change in manufacturing procedure. I can also recall during the first World War days the way dyestuffs and many organic chemicals were cut off. However, in both these cases, it was possible to experiment, perfect manufacture, and develop replacements, before going into full time production. This sudden change in the silk situation, however, has made the knitter take immediate steps and experiment on a production scale in order to insure any output at all from his plant.

We are all aware of the fact that experiments on a production scale are costly, both from the standpoint of lost production and improperly manufactured goods.

In this particular discussion, however, we are more interested in the processing materials to use in the treatment of these materials used to replace silk than we are in the actual mechanical operations of throwing, knitting, etc. Both problems are in many respects related, and both are extremely important in the proper production of satisfactory hosiery.

It is evident that the materials at the present time which are to be used in the manufacture of full fashioned hosiery will be nylon, rayon, Bemberg, and cotton. At the present time it does not seem probable that the acetate yarns will be of particular importance in this type of knitting.

The first operation necessary to provide a yarn suitable for knitting is the throwing process. In this process the yarn is doubled if necessary, twisted, and lubricated, so that when the knitting operation is reached the yarn will have the necessary properties to run freely on the machine, and at the same time for the proper stitch.

For purposes of comparison, we will note the differences between silk and the synthetic and cotton yarns mentioned. Silk is a protein and the fiber itself is protected by a coating of sericin, commonly called gum, representing about 20 per cent of the total weight of the silk.

This natural gum forms a protective coating which provides protection against abrasion and handling during the knitting process. It must be removed previous to dyeing, however, and the silk fiber itself is then laid bare for dyeing and finishing operations. In the throwing operation, when silk is employed, it is necessary to soften or plasticize this outer coating of sericin so that it will be more pliable and better prepared for the mechanical operations of throwing and knitting. This is accomplished by soaking the silk skeins in an emulsion of oil and alkalies.

Neither the synthetic fibers nor cotton are provided with any type of protective coating, so the preliminary process, before knitting, of necessity will have to take this into consideration. The fiber must be treated in such a manner that it will have sufficient pliability or firmness to proceed through the mechanical process without injury.

Regarding nylon, this fiber has been in practical application for a sufficient time for the hosiery manufacturers to determine the best manner to handle it for his particular method of manufacture. It is, therefore, not necessary to go into the details regarding this particular yarn.

For at least some period of time, rayon probably will represent the largest amount of yarn used in the production of full fashioned hosiery. The yarn which is now being provided by the rayon manufacturer requires further treatment before it can be satisfactorily knit. Opinions among the knitters at the present time vary considerably regarding just exactly how this yarn should be treated. There are two general prevailing opinions, and strange as it may seem, these two opinions seem to be entirely opposite in nature.

One group of manufacturers believes that the rayon should be heavily treated with oil in order to make the fiber practically limp; the other group recommends the *sizing* of the yarn previous to the throwing operation in order to supply the yarn with a slight degree of firmness, thus preventing snarling on the machine and producing a clean cut stitch. This latter procedure is a development arising from nylon experience, and is also related to the former practice of silk soaking.

Both of these ideas seem to work out satisfactorily, particularly under certain conditions. It may be possible that the knitters using one method could not readily adapt themselves to the other, and vice versa, but where either one of these practices have been followed, the results seem to be satisfactory.

In case it is desired to use the oil method alone, it is

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the practice to immerse the cone or skein in a neat oil and permit the fiber to become saturated with the oil. In some cases, when the yarn is on cones, the practice is to immerse half the cone for a period of 15 to 20 minutes, then withdraw the cone, inverting it so that the excess oil may diffuse through the balance of the untreated yarn.

It is also a practice, in some instances, to dilute the neat oil with some type of solvent like a cleaner's solvent. This dilution is practiced for the purpose of regulating the amount of oil to be applied to the yarn. As the solvent evaporates, the neat oil itself remains; and consequently, the degree of dilution will properly regulate the amount of oil actually taken up by the fiber. Two grades of oil are used for this type of work.

One is an unsaponifiable oil preferably water-white in color, the viscosity of which may vary between 55 and 80 seconds. This type of oil can be permitted to remain in the fiber for an indefinite period of time without any danger of oxidation or rancidity.

The other type of oil employed for this purpose is an unsaponifiable oil mixed with a percentage of saponifiable oil, sufficient to insure easy scourability. This particular type of blended oil is blended with a lighter viscosity mineral oil, but the viscosity of the finished blend is approximately the same as that of the unsaponifiable oil previously mentioned. While the latter type of oil probably scours more readily than the first type, both may easily be removed with sufficient ease to assure proper dyeing.

When the yarn is to be sized before throwing, it is most satisfactorily done in the skein form. The sizing solution is composed of from two to four pounds of the proper sizing material, and from 14 to 16 pounds of the proper type of soluble oil, mixed in 60 gallons of water. This sizing solution is applied by soaking the yarn at a temperature of 140° F. for 20 minutes. The skeins are then removed from the sizing solution and whizzed to approximately 100 per cent gain in weight, and then dried in the usual manner.

This size bath may be used repeatedly by merely making it up to volume with the original strength solution. Practically no exhaustion takes place in this bath and the size put on the yarn is merely the take-up from the solution, and can be regulated to some extent by the degree of drying in the extractor.

The commission throwster probably prefers the oil immersion method in preference to the sizing, as he can regulate his clearances and obtain better figures by that method. The sizing operation is performed in practically the same manner that is now in general practice for weaving yarns, except that a sizing agent other than gelatine is to be preferred.

The preparation of Bemberg yarn is somewhat simpler, as practically the only operation necessary in this type of yarn is to apply the lubrication at the coning machine. In this instance an emulsifiable oil is used, but it is applied in the neat form. This type of oil is of a select composition, composed of both mineral and saponifiable oil. The mineral oil should be of a grade which will not oxidize readily and cause discoloration, and the saponifiable oil should be of low iodine value so that no rancidity or oxidation can easily take place. The amount of oil applied to the yarn is regulated by the speed of the roller in the trough and the speed of the coning machine itself.

Where mercerized cotton yarns are used, there are two methods by which the yarn may be properly lubricated. If the yarn is mercerized by the skein process, the lubricant may be applied in the last bath in the form of a soluble oil; however, for chain mercerizing it is necessary to apply the lubricant on the coning machine in the same manner as that described under Bemberg, but in this instance an emulsion of oil is used instead of the neat oil. This emulsion is usually strong and composed generally of 1 part of oil and 1 part of water. The oil in this instance should be of the type which will not oxidize and turn rancid so that no discoloration will take place which would cause difficulty in the dyeing.

In the event that the cotton is to be dyed before knitting, the lubricant should be applied in the last rinse bath to give the yarn proper lubrication. This lubrication is assisted and aided by using an emulsion of soluble wax on the coning machine when the yarn is coned. This soluble wax should be of the type that will remain in emulsion in cold solution. This wax emulsion can also be used on undyed mercerized yarn, particularly in the event that previous lubrication has been applied to the yarn before the coning operation. Many knitters prefer this wax treatment as it provides a slick surface to the yarn and assures easy knitting.

We have covered the three principal types of yarn in regard to preparation before throwing or knitting. Rayon yarns after being given the treatments described, are put through the regular throwing process which applies the proper twist, but the Bemberg and cotton treatments do not necessarily take place in the throwing mills as the treatments described are given just prior to knitting.

After the hosiery is knit, the next probem is the proper dyeing and finishing. The methods to be applied necessarily vary considerably from those regularly used in the dyeing of all silk hose or silk hose which contain cotton welts, toes, heels, etc. In the case of silk, it is necessary to remove the gum in order to insure proper dyeing. This necessitates an alkaline bath which is generally composed of either soap or some type of a soluble oil combined with alkali. The operation is done by either the single, split bath or double bath method, which methods are well known to all dyers of silk hosiery.

In the case of rayon, cotton, nylon, or any type of synthetic yarn, there is no gum to remove, but it is necessary to boil-off and remove any type of lubricant or sizing material in which the yarn has previously been treated. This operation can also be performed in either a single, split bath or double bath operation, depending entirely on

the type of fabric being treated. The preferable method, however, in most all instances, is to use the scouring bath as a preliminary operation and throwing away either all or a large portion of it. Incidentally, in the dyeing of rayon and hose made from other types of synthetic fibers, the hose should be properly bagged and preferably in smaller bags than usually employed to prevent tangling, as these types of hose seem to have a tendency to tangle somewhat worse than silk.

A very important function, preliminary to dyeing of cotton and rayon hose, is the proper wetting out of the fabric to insure level dyeing and proper dyeing of the seams.

Quite a few dyers are of the opinion that a wetting-out agent or so-called penetrant assists in the dyeing by forcing the dyestuff into the fabric. The actual operation of these surface active agents is just the contrary. The actual action which takes place by the use of the proper agent is first, a complete wetting out of the fiber. This permits an easy access of the dyeing liquor so that every portion of the fabric is reached by the solution. Secondly, the wetting-out agent retards the action of the dyestuff and thus insures an even distribution of the dye, resulting in a level color.

When the seams of hosiery are not properly wet out at the start of the dyeing operation, they do not dye at the same rate as the balance of the fabric. As the dyeing proceeds, the dye bath becomes weaker, and consequently does not have sufficient strength to dye the seams with as heavy a shade as that imparted to the balance of the hose. It is, therefore, very important that the hose, particularly in the seams, be thoroughly wet out before the dye bath is made up in proper strength. For some reason, considerable difficulty has always been experienced in the dyeing of seams of rayon hosiery. Possibly this is because the wetting-out function has not been properly accomplished and consideration has not been given to the fact that the sewing thread used on the seams is generally of a much higher twist than the balance of the fabric, naturally requiring more drastic treatment.

The penetrant, or wetting-out agent, should be applied at the start of the operation in the scouring bath. This penetrant may be combined with a soap or scouring agent, or it may be in the form of a combined penetrant and detergent. If soft water is employed, the preferred penetrant is one having the form of a liquid oil which is efficient at low concentration, giving a complete wetting out of the fabric in a short period of time, combined with a good grade of textile soap. In the event that only hard water is available, a synthetic detergent should be employed; if the detergent does not have a high degree of wetting out ability at low concentration, it should be combined with a wetting agent which will effectively perform at the most economical concentration.

After the wetting out and preliminary scouring action, a wetting-out agent and leveling agent should be employed in the dye bath. If the dyeing operation is done by the one bath method, the selection of the penetrant should be the same as that employed in the dye bath. It should be preferably of an oil nature which will perform efficiently in its wetting-out ability, and at the same time supply to the yarn the proper degree of lubrication, yet not affect the level dyeing properties of the dyestuff. The selection of this type of penetrant assures proper lubrication of the yarn during the dyeing operation, preventing friction and leaving the fabric with a soft and pliable hand.

The temperature of the scouring bath and the dye bath is naturally regulated by the type of fabric being dyed. Viscose rayon and cotton can be dyed safely at practically any temperature; the most acceptable temperature is about 210° F., or just below the boil. There is no reason why these fabrics may not be employed at the boil, but many dyers find when they use considerable soap in the dye bath that excessive foaming takes place at the boiling point. This foaming may be prevented by lowering the concentration of soap and employing one of the chemical detergents which do not foam as heavily, particularly at the boiling point. It is also an advantage to use a penetrant or wetting-out agent that has emulsifying properties of mineral oil, as mineral oil is present in the rayon and cotton yarns. The use of a wetting-out agent of this character decreases the amount of soap necessary, and also reduces the tendency for excessive foaming.

It has been generally conceded that the scouring properties of the bath are in direct proportion to its sudsing action. This, however, is not entirely true, as it is possible to remove a great many materials, particularly mineral oil and similar materials, without any sudsing action, merely by proper emulsification. Suds and foam have a tendency to float and remove insoluble particles such as dirt, but this suds does not necessarily remove mineral oil.

Several instances have occurred recently where difficulty has been encountered when nylon has been knitted with a cotton welt. The cotton welt has shown a tendency for unevenness, and some dyers have been of the opinion that this is caused by the nylon size adhering to the cotton welt during the preboarding process. It has not been definitely proven that this is the cause of this unevenness, and tests made by spotting the size on cotton do not indicate that size causes this effect. However, this difficulty may be largely avoided by raising the temperature of the scouring dye bath to the maximum and employing the two-bath method of scouring and dyeing.

The methods cited and the points to be observed apply to practically all dyeing of synthetic and cotton hosiery, as almost all mixtures are handled in the same manner. In the case of Bemberg welts, however, it is not advisable to use as high a temperature as that employed with the other yarns. This also applies to acetate yarns, but it is improbable that much acetate will be incorporated in full fashioned hosiery.

While the handling and dyeing of these yarns for full

fashioned hosiery may be a new problem in a great many mills, the circular knit trade has employed these yarns for many years, both alone and in various combinations. It is a common practice in the half hose industry to combine cotton, rayon, acetate and in many instances silk, in the same hose, thus permitting the dyeing of several colors in the same dye bath. For further variation, in many instances they knit into the hose dyed yarns of a dye-resistant character so that the number of colors may be increased. The use of alkali in the scouring and dye bath is necessary in most instances, and will not detrimentally affect rayon, nylon, and cotton; but in the case of Bemberg and acetate, considerable care must be used in the selection of alkali, using only those types which have a comparatively low pH.

The delustering and finishing of dyed hosiery is handled in the same manner as that employed with silk hosiery. The various delustering compounds are usually composed of either insoluble barium or titanium compounds, or colloidal clays; and these products will work satisfactorily on rayon.

In regard to the finish to be used on the various types of synthetic yarns and cotton, presumably it will be the same as with silk hosiery, in that practically every mill will have a different idea regarding the exact finish they desire on hosiery. This finishing proposition evolves into practically a separate problem for every manufacturer.

For the past two or three years, manufacturers of hosiery have been directing their attention to finishes of the so-called permanent type—finishes which will not be easily removed in washing, and to some extent form a protective coating on the yarn and assist in resisting snagging. These types of permanent finishes are particularly adaptable to rayon and the synthetic yarns, as they may to a certain extent assist in the wet strength of the yarn and permit easier washing. The present national emergency situation has interfered considerably in the development of these permanent finishes, as practically all of them have a base of synthetic resin, and the difficulty of obtaining formaldehyde at the present time has interfered with the supply of these products for non-essential industries.

The knitting of rayon, particularly in regard to its lack of elasticity, offers an opportunity for the development of finishes which will prevent bagging of the hose and tend to preserve the original appearance. Undoubtedly the future will see many new developments in finishes for the new hosiery, and it will be necessary for the manufacturer to experiment extensively in order to obtain the results he desires in finished hose.

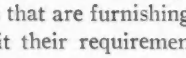
It can readily be observed that the treatment of yarn, and the knitted hosiery which will represent the large percentage of the future production of the full-fashioned industry, presents somewhat different problems from those formerly encountered when handling silk. But on the whole, these problems are not particularly difficult of solution, and probably eventually will be more easily handled than the problems formerly presented with silk.

The man-made fibers have one advantage in being more uniform than silk, which varies from crop to crop and from year to year. Therefore, when the proper manufacturing procedure has been developed, the question of non-uniformity will be largely eliminated. It must be borne in mind, however, that rayon manufactured by different rayon manufacturers, has slightly different characteristics, and needs in many instances slightly different treatment, particularly in the dyeing.

It should be noted, with a great deal of credit to the hosiery industry, that they have not spent much time in regretting that this change has been forced upon them. Instead, they have gone to work immediately with thought for the future, and have endeavored to make the best out of the materials available to maintain their production, and supply the consumer with usable and attractive merchandise.

This attitude on the part of the manufacturers represents the general spirit of the times, and we can all be assured of the fact that none of the problems presented are unsolvable.

The knitter and dyer are finding hearty cooperation from those concerns that are furnishing them with processing materials to suit their requirements.



Textile Education—

(Continued from page P86)

dividual and the class with their test scores. We are also having a number of our faculty members rate each student each year on a personnel rating sheet which contains twenty-two items that we feel are most important. We also request the student to rate himself, and then sometime during the year each young man is called in, and in a private conference we discuss his own rating as compared to that given by three or four faculty members independent of each other. This enables the student to see himself as others see him, and we feel that we are already able to see some results from this program. All of the information goes into the man's file. In addition, we have developed our own application form. Here again we made a study of the application blanks from a number of firms. We selected those questions that seem to be most important, and made up our own senior record card with the thought of expediting the matter of placing information in your hands when you come to the textile school seeking a graduate. This means that when you come into the school seeking a certain type of graduate, you will be furnished information on the entire senior class and can select those men that you would like to interview. If you

cannot come into the school, we send this information to you with the request that you return it as promptly as possible after you have selected your men.

Another subject that we feel must be covered in a textile curriculum is that of government regulations and labor relations. We all recognize that government regulation and organized labor are here to stay, and if these men who come to us for training in the industry are going to be properly equipped to do the job for you, we cannot continue to bury our head in the sand on matters of this type. Naturally a program of this kind will have to be handled with the utmost circumspection to see that all sides of the problem are presented in a fair and unprejudiced manner. Certainly the graduate should know what the plant can and cannot do, what government regulations and laws apply particularly to textile concerns, what rights and privileges labor is entitled to, and what rights and privileges the management is entitled to. These are the tools of management.

There is a great opportunity awaiting the textile schools in the field of color and design, and there has been a great deal of talk and some action in connection with making New York, or this country, the style center of the world. Our economy is a mass production economy; however, at the same time we all know that American people are the best dressed people on earth. One of the starting points, or probably I should say *the* starting point in any program to develop a style center in this country, will be a thorough and complete historical background of textiles in manuscript, in swatches and in colored slides and film of those fabrics, in the various museums, that will not bear handling. Nothing like this has ever been done for textiles, and every worthwhile museum in this country should be covered thoroughly and completely by a trained group of men. Here is a real project for one of the foundations who would like to do something worthwhile in the field of textiles. At our own school in Philadelphia we have the very fortunate combination of a museum, an art school and a textile school in the same corporate family. The School of Industrial Art is just as widely known and has just as fine a reputation in its field as does the Textile School. We already have joint committees at work in both schools looking towards the development of a curriculum in textile designing, using the facilities of both schools. I have often heard that one of the reasons Paris was the fashion center of the world was that it was possible to get a few yards of almost any fabric the designer wished to see woven by some of the hand weavers in and around Paris. We still believe that hand looms are an absolute necessity in textile instruction, and at Philadelphia we have some forty-five or fifty hand looms equipped with dobby heads and jacquard heads; and we can do practically anything on a hand loom that can be done on a power loom. It would seem to me that the textile schools might be of some help in this program to make America the style center of the world, and I feel certain that each and every one of the schools would be delighted to cooperate to the fullest extent of their facilities.

ONE HUNDRED AND THIRTY-SIXTH COUNCIL MEETING

THE Council held its 136th meeting at the Engineers' Club in Boston, on Saturday morning, January 17, 1942. Present were President Thomas R. Smith, presiding; Charles A. Seibert, Vice-President; William R. Moorhouse, Treasurer; Louis A. Olney, Chairman of the Research Committee; William H. Cady and Carl Z. Draves, Past Presidents; Dexter R. Kneeland and Clarence L. Nutting representing Northern New England; Allison R. Fletcher and Frederic A. Prisley representing Rhode Island; J. Ernest Meili, George A. Moran and Harold W. Stiegler representing New York; John F. McCoy representing Philadelphia; L. M. Boyd and Albert H. Grimshaw representing Piedmont; Robert W. Philip representing Southeast; Jack Anderson representing South Central; and Harold C. Chapin, Secretary.

The Secretary's report of the 135th Council meeting and financial report of January 10, and the Treasurer's report of January 16, were accepted. A report was received from the Finance Committee on new Corporate memberships. Reports from the Treasurers of the Mid-West and Southeastern Sections were approved. Mr. Ryberg's salary for 1942 was voted; also the investment of $7,400 in National Defense Bonds. Henry H. Herrmann was reappointed Chairman of the Publicity Committee.

Thanks were voted to the Piedmont Section for its management of the Pinehurst meeting. The invitation of the Philadelphia Section for the General Meeting of 1942 was accepted, with choice of place, and of date within the last three months of the year, left to the discretion of the Section. Kenneth H. Barnard was again appointed Chairman of the Program Committee. A letter from E. H. Killheffer, advocating restriction of expenditures on Sectional Competition papers, was referred to a committee to be appointed by the President. It was voted that the next Council meeting be at the North Carolina State College, in Raleigh, on April 18.

To Corporate membership were elected Amazon Cotton Mills, American Viscose Corporation, American Woolen Co., Buffalo Electro-Chemical Co., Cannon Mills Co., Delta Finishing Co., Ewing-Thomas Corporation, Laurel Soap Manufacturing Co., James Lees & Sons Co., Marshall Field & Co., National Oil Products Co., Sayles Finishing Plants, Inc., Trion Co., Union Bleachery, Warwick Chemical Co., West Point Manufacturing Co., and Wiscassett Mills Co. Each of the following was elected to the class of membership specified, as of thirty days from publication of application, provided no objection be received meanwhile by the Secretary:

SECRETARY'S RECEIPTS, AUGUST 1, 1941, TO JANUARY 10, 1942

Received and Transmitted To Treasurer	*Applications*	*Dues, Regular and Reinstate.*	*Dues, Corporate and Sustaining*	*Miscellaneous*	*Totals*
August 1 to October 23, 1941	$340.00	$3,693.75	$350.00	$297.32	$4,681.07
October 23, 1941, to January 10, 1942	640.00	6,299.75	3,152.50	1,263.50*	11,355.75
Total in fiscal year to date	980.00	9,993.50	3,502.50	1,560.82	16,036.82
Leaving deposited by Treasurer with Secretary					500.00

Miscellaneous Items*

General meeting registrations	$831.00
Year Books	353.83
Reporters	1.70
Publicity pamphlets	2.00
Buttons	4.50
Moth cloth	27.50
Knitted tubing	4.71
Dyed standards	27.50
Crock cloth	12.00
Water testing apparatus	.68
	$1,265.42
Bank charges	—1.92
	$1,263.50

Senior

M. L. Baran	R. M. Haas	B. R. Roberts
P. T. Bodell	T. Hadfield	C. P. Robinson
M. B. Calder	E. F. A. Herr	R. E. Rogers
R. W. Canavan	L. A. Heuer	L. E. Rossiter
J. J. Cervini	M. Horbal	C. Shelton
O. Conrad	J. Hoye	C. A. Soffera
S. Converse	R. M. Hughes, Jr.	P. C. Staley
D. P. Dameron	A. I. Hultberg	J. H. Stradley
J. E. Dempsey	H. J. Hunziker	H. I. Stryker
E. N. Ditton	R. H. Johnson	F. A. Tagliabue
E. Driscoll	W. R. Jones	J. L. Taylor
L. Edgerton	H. F. Leupold	L. Tranger
G. T. Eichler	P. R. Lindsay	G. A. Urlaub
R. L. Faber	G. R. Link, Jr.	J. O. Wauford
A. F. Fiddes	E. A. Lutz	J. B. Wilkinson
J. H. Fiebiger	M. Macuga	R. S. Wilkinson
S. G. Finley	C. L. Mantell	C. B. Williams
R. H. Funke	C. M. Mathieu	W. B. Wilson
M. S. Furry	P. E. Morally	L. Wineburgh
J. J. Glenn	J. R. Nehmens	G. L. Wyatt
C. F. Goodman	P. M. Parrott	L. J. Wyman
O. Grosz	W. C. Penrifoy	L. L. Wyss
	P. Petty	
G. P. Cleveland	K. B. King	C. R. Sandner
C. A. Cobb	J. V. Kopycinski	J. E. Sands
W. B. Coffin	A. C. Lamas	T. J. Sarandria
A. E. Culp, Jr.	W. A. Lane	J. E. Scott, Jr.
O. P. Durheimer	E. H. Largen	M. Siegel
R. P. Farren	R. C. Leak	M. J. Smith, Jr.
H. G. Ferree, Jr.	J. Linton	R. N. Smith
R. M. Fichtler	J. C. Mackey	T. E. Stevens, Jr.
D. B. Finn	E. Magat	F. Stott
L. A. Fiori	P. J. Martin	W. B. Sutherland
A. M. Frank	J. B. Masaschi	E. A. Taylor, Jr.
A. Gordon	L. M. Mayo	J. J. Terranella
E. H. Grosse	G. W. McGarity	L. L. Trexler
D. O. Hamer, Jr.	J. N. McJunkin	K. Valner
C. N. Harper	J. G. Melton	J. W. Webster
W. A. Hewitt	A. E. Mitchell	W. W. Webster
H. H. Hodges, Jr.	G. C. Murphy	W. H. Weisz
W. R. Ivey, Jr.	J. A. Murphy	J. D. Williams
J. T. Johnson	M. H. Newton	H. L. Wood
A. N. Kaplan, Jr.	J. L. Nisbet	D. W. Yates
	C. R. Puliafico	

Junior

S. Backer	C. H. Hood, Jr.	W. L. Ruhe, Jr.
J. H. Binns	B. P. Lynam	E. H. Schwarze
H. E. Borton	A. O. Potter	M. P. Shelton
T. S. Greenwood	N. B. Ritchie	R. C. Temple

Associate

J. W. Ames	H. Craig	J. Neiman
D. J. Benoliel	H. R. Davis	W. L. Reeves, Jr.
L. O. Benoliel	A. P. Gumaer	C. F. Rutherford
O. W. Bredbury	J. B. Little	J. T. Wigington
J. F. Carey	H. C. Meegan	R. P. Young

Student

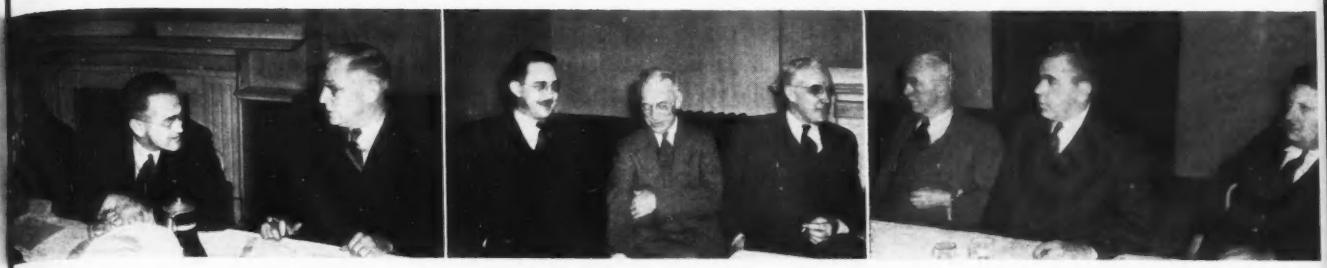
L. B. Barnes	J. P. Kelleher	E. M. Ransom
S. Berman	P. Kenin	J. P. Rulli

The following were transferred from other classifications to Senior membership:

J. Boyko	B. J. Hodes	E. E. Rittberg, Jr.
W. E. Brand	R. A. Lemieux	G. Rock
W. F. Brommelsick	B. L. Lizak	T. Rusticus
T. E. Carr	H. P. Loveless, Jr.	L. R. Scolavino
B. R. Celentano	B. E. Lukens, Jr.	W. H. Sites
L. Cesaletti	A. Malick	C. O. Stevenson
E. Collier	C. P. McCann, Jr.	R. L. Tanis
E. L. Dion	L. E. Moody	P. W. Volk
W. H. Espelin	J. J. Moulson	G. P. Whitcomb
F. C. Gaddy	J. H. Orr	R. W. Wilson
W. S. Gilbert	J. J. Pizzuto	B. P. Wishnietsky
W. Hargreaves	M. D. Plovnick	J. A. Woodruff
H. M. Hartnett	R. I. Peters	

Respectfully submitted,

HAROLD C. CHAPIN, *Secretary.*



Photos by Robert W. Philip

AMONG THOSE PRESENT AT THE MEETINGS OF THE RESEARCH COMMITTEE AND COUNCIL ON JANUARY 17th IN BOSTON:

Left to right—Clarence L. Nutting, Dexter R. Kneeland, William R. Moorhouse, Robert W. Philip, Walter S. Williams, Ralph F. Culver, Ben Verity, L. M. Boyd and Jack Anderson.

ONE HUNDRED AND TWENTY-NINTH MEETING OF THE RESEARCH COMMITTEE

THE 129th meeting of the Research Committee followed the Council meeting in Boston on January 17, 1942. Present were Chairman Louis A. Olney presiding; J. Anderson, L. M. Boyd, K. H. Barnard, H. Christison, W. H. Cady, R. F. Culver, H. D. Clayton, W. C. Durfee, J. N. Dalton, C. Z. Draves, A. R. Fletcher, A. H. Grimshaw, A. C. Goodings, A. E. Hirst, N. A. Johnson, D. R. Kneeland, D. P. Knowland, O. F. Marks, W. R. Moorhouse, G. A. Moran, J. F. McCoy, J. E. Meili, C. L. Nutting, R. W. Philip, F. A. Prisley, R. Robertson, B. A. Ryberg, C. H. A. Schmitt, J. Shanks, T. R. Smith, C. A. Seibert, H. W. Stiegler, W. von Bergen, B. Verity, W. S. Williams, and H. C. Chapin, Secretary.

The Chairman outlined agenda for the meeting and recent accomplishments, particularly the work of the committee appointed to advise the Philadelphia Quartermaster Depot on olive drab wool dyeing. There was further discussion of arc fading lamps. Mr. Durfee and Mr. Ryberg reported on Crock-meter standards, advocating gray rather than colored, and showing various devices suggested for producing appearance of crock spots in standards of greater permanence and convenience. Mr. von Bergen reported using spectrometer measurements as records of spot intensities, and Mr. Seibert emphasized importance of slow motion of the Crock-meter in getting reproducible results.

Dr. Stiegler, reporting for the Committee on Water Resistance of Fabrics, stated that occupation of instrument makers with war work had thus far prevented manufacture of hydrostatic pressure testers for sale; but that a few of the spray testing outfits, prepared by Mr. Ryberg, were available at the Lowell Textile Institute as stated in the 1941 Year Book. He stated that it would probably be necessary to develop another test for water resistance under mechanical compression or rubbing. Dr. Draves called attention to the need of better definition of weathering in governmental specifications dealing with water resistance after weathering.

The field of Mr. Marks' Committee on Shrinkage of Rayon Fabrics and of Mr. Knowland's on Wash Fastness of same, was extended to fabrics of all manufactured organic fibers. Mr. Schmitt suggested that under wash fastness fabrics be classified by uses rather than fiber composition; and Mr. Seibert that draperies, requiring light fastness rather than wash fastness, be subjected to a much less rigorous washing test than other fabrics. Mr. Seibert reported on the new test for fastness to chlorine now incorporated in Quartermaster Depot specifications, and on the efforts of his committee to produce satisfactory dye standards for chlorine fastness. He raised the question whether the committee should confine itself to dyes subjected to chlorine in common practice, or should select any dyes conforming to the desired degrees of fastness. With Mr. Cady, he showed blue prints of an oven for testing fastness of dyed rayon to gas fading, copies of which are soon to be available for general distribution.

Dr. Goodings discussed testing of textile war materials by the Ontario Research Foundation, complicated by differences between British and United States specifications; stating that besides testing for conformity to specifications, the Foundation had been able to give mills much helpful advice on production to meet them. He suggested incorporating methods for testing resistance to mildew in a more generally recognized standard test, for which the Chairman proposed organization of a committee.

Respectfully submitted,

HAROLD C. CHAPIN, *Secretary.*

MEETING, PHILADELPHIA TEXTILE SCHOOL STUDENT CHAPTER

THE first meeting of the Philadelphia Textile School Student Chapter for the college year 1941-1942 was held November 10th. Chairman Joseph Dunson called on John McCoy, Chairman of the Philadelphia Section and President of the Edgewater Dyeing and Finishing Co., to deliver a talk on "The Dyeing and Processing of Cotton Materials." Mr. McCoy's talk was very interesting, relating some of his past experiences and telling of some of the problems of his plant.

Respectfully submitted,

ERNEST STEWART, *Secretary.*

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward to the secretary a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the American Dyestuff Reporter any vacancies which may occur in their business.—H. C. Chapin, Secretary, Lowell Textile Institute, Lowell, Mass.

NOTICE TO EMPLOYERS

Personal Histories and Employment Records of the following applicants are on file at the office of the American Dyestuff Reporter. Prospective employers may examine them without obligation.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE SECRETARY OR THE AMERICAN DYESTUFF REPORTER AT ONCE.

A-1

Education—Graduate textile chemistry and dyeing course, Lowell Textile Institute, 1932. Special course in colloid chemistry at M.I.T.

Experience—Library work in spare time while attending school; five years as assistant chemist with knitting mill, duties consisting of testing and grading silk, testing of oils, soaps, dyes, finishes and other chemicals, making up specifications for various lines of hosiery and checking finished product, keeping a check on production costs, control of waste and irregulars, checking competing products and carrying on research to improve product and reduce costs. Woman; age 30; references.

A-2

Education—B.T.C., Lowell Textile Institute, 1933.

Experience—Textile chemist, cotton and rayon thread; agricultural chemist, protein, fat and mineral analysis; special Federal inspector on textiles, New York City; U. S. inspector, war department; chemist-spotter, dry cleaning experience. Age 32; married.

A-3

Education—B.S. in chemistry, Lehigh University.

Experience—Experimental engineer and analytical chemist, 8 mos.; assistant superintendent of silk corporation, assisted in planning and directing production, in charge of laboratory, technical work, personnel, purchasing, etc., 2 years; inspector of ordnance material, to the present. Seeks position as chemical engineer or chemist.

Age 25; single; references.

A-B-9

Education—Textile School Graduate; Alexander Hamilton Institute Business Course.

Experience—Mature, executive type of textile chemist and colorist with over twenty years' broad general experience in factory, laboratory, purchasing and all around business procedure. Good correspondent. Excellent personality. Wholesome appearance. Fine speaker. Literary and artistic ability. Real color sense. Possesses fund of factual information about material things in a wide range of industries. Capable of meeting the highest type of clientele and planning and directing the efforts of all types of personnel. Desires supervisory, contact, promotional or sales work. Willing to prove ability and versatility.

Age 44; American born; New England Yankee ancestry; married.

A-B-16

Education—3 years analytical textile chemistry and 2 years textile dyeing at Rhode Island School of Design.

Experience—6 years assistant research chemist at cotton finishing plant. Had charge of putting all research into production; complete study of starches, dextrines, gums, resins, finishing oils, softeners and sulfonated oils; considerable microphotography experience; wash and light tests on dyestuffs; knowledge of all cotton finishing operations; experience in water treatment; recent experience as dyer of wool, cotton, rayon (stock and piece goods), and mixtures. Seeks position as chemist, dyer or laboratory technician.

Age 30; American; married; references.

A-B-17

Education—Graduate of Franklin Union and Lowell Textile Institute, 1942.

Experience—1936 until present as assistant dyer in hosiery dye works. Experienced on full fashioned and anklet hosiery, handling wool, cotton, silk, rayon and nylon and combinations; has charge of weighing dyestuffs, testing and shade matching; experience with hosiery dyeing machines of all sizes. Seeks position as assistant dyer or laboratory technician.

Age 24; married; references.

A-B-18

Education—Graduate Philadelphia Textile School, 1940.

Experience—Has experience as assistant chemist and trouble shooter in silk dyeing and finishing plant; as manager of laundry store; and as printer and colorist in screen printing plant. Seeks position in laboratory and research, dyeing, printing or finishing.

Age 21; single; references.

A-B-C-F-3

Experience—Broad experience since 1906 as overseer of finishing, general researcher, trouble shooter, overseer of dyeing, general superintendent, mill manager. Experienced in woolen, worsted, cottons, unions and mixtures. Recently specialized in men's wear cottons. Seeks position as overseer of finishing or dyeing, assistant superintendent, superintendent or manager.

Age 53, married; references.

A-C-D-1

Education—Chemistry, Temple College, Philadelphia, evenings. Dyeing and textile chemistry, Philadelphia Textile School.

Experience—Employed about 18 years in textile mill, becoming chemist; 5 years as superintendent of finishing on silk and rayon ribbons; 10 years as salesman of chemicals and textile specialties in eastern Pennsylvania and parts of New Jersey; has some knowledge of the processing of all textiles. Seeks position as salesman with well known company.

Age 48; married.

B-10

Education—2 years chemistry, 2 years textile chemistry and dyeing, Lowell Textile Institute, evenings.

Experience—4½ years dyeing and bleaching hosiery, specializing in children's and infants' hose; 3 years assistant dyer, dyeing and bleaching cotton, mercerized and unmercerized, wool, wool-cotton, wool-rayon and wool-silk hose. Seeks position as second hand, assistant dyer or laboratory assistant in hosiery mill.

Age 27; single; references.

B-D-1

Education—High school graduate; textile chemistry, Textile Evening High School, New York City; accounting; typist.

Experience—from 1935 to present employed as colorist with screen printing plant in New York City. Experienced with all types of fibers and all types of dyes. Shade matching. Versed in accounting, typing, modern office procedure and sales promotion. Able assistant to busy executive. Age 46; single; references.

TRADE NOTES • NEW PRODUCTS

• HARTEX DIGEST

The first issue of "The Hartex Digest," published for the Hart Products Corp., 1440 Broadway, New York City, appeared recently. It is described as a time-saving reading guide to textile trade papers for the busy plant executive. It consists of brief descriptions of articles appearing in textile journals, classified according to the executive to whom they would be of most interest and indexed by title and page.

• RED CROSS QUOTA FILLED

One of the earliest to report fulfillment of its quota in the Greater New York $7,330,000 Red Cross War Fund appeal was the chemical industries division under the chairmanship of W. E. Cotter, of Union Carbide Co., as reported at a general meeting of Division Chairmen at the Biltmore Hotel on Wednesday, January 28th. Fletcher Rockwell, of National Lead Co., is Chairman of the Dyestuffs Industry Sub-division. Henry G. Sidford, of National Lead Co., represents the paint and varnish sub-division as vice-chairman.

• MATHIESON FIFTIETH ANNIVERSARY

The Mathieson Alkali Works, Inc., producer of bleaching agents and other chemicals used in the textile industry, is observing its fiftieth anniversary. The company was incorporated in Virginia in 1892.

With plants in Saltville, Va., Niagara Falls, N. Y., and Lake Charles, La., Mathieson is one of the major producers of alkalies, chlorine, synthetic ammonia, and numerous other products. At present, all three plants have been geared to maximum production to supply chemicals vitally necessary to our all-out war effort.

It is stated that, half a century ago, all of the bleaching powder and most of the alkali consumed in this country were still imported from England, and the prejudice in favor of the imported products was strong. To insure a product equally as good, construction and initial operation of the new company's plant was entrusted to a retired English alkali manufacturer, Neil Mathieson. He sent a son, Thomas T. Mathieson, to this country, and under the latter's supervision a plant was built at Saltville, Va., where there are huge and historic salt deposits.

About the same time, Mathieson obtained control, in this country, of the Castner electrolytic cell for the manufacture of caustic soda and chlorine, and to obtain cheap power, a plant was constructed at Niagara Falls, N. Y. Production began in this plant late in 1896.

Other accomplishments claimed for Mathieson include the commercial production of synthetic ammonia in 1923; the development of a true calcium hypochlorite as a new chlorine carrier in 1928; the development of sodium chlorite as an improved bleaching agent for textiles, paper, flour, and other materials in 1939; fused alkalies in briquet form for a variety of uses; synthetic salt cake to replace foreign supplies for kraft paper manufacturers; exceptionally pure dry ice and carbonic gas from carbon dioxide, obtained as a by-product from the ammonia soda process at Saltville; especially designed containers for the shipment of liquid chlorine; and the distribution of caustic soda in liquid form in tank cars and in a specially designed sea-going tanker, plying between Lake Charles and Norfolk, Va., where Mathieson operates a liquid caustic storage terminal.

• DYESTUFF ADVISORY COMMITTEE

The formation of a Dyestuff Manufacturers Industry Advisory Committee was announced on February 3rd by the Bureau of Industry Advisory Committees of the War Production Board.

Dr. Arnold L. Lippert of the Textiles, Clothing and Leather Goods Branch of the WPB has been designated Government Presiding Officer.

Committee members are:

A. R. Chantler
E. I. du Pont de Nemours & Co.
Wilmington, Delaware

E. K. Halback
General Dyestuff Corp.
New York City, N. Y.

S. C. Moody
American Cyanamid Co.
Bound Brook, New Jersey

Dr. H. B. Marshall
Ciba Co.
New York City, N. Y.

Jack Crist
Southern Dyestuff Corp.
Charlotte, North Carolina

T. Thomas Roberts
Arnold Hoffman & Co.
Providence, R. I.

C. M. Richter
Pharma Chemical Corp.
New York City, N. Y.

• JOINS SCHOLLER BROS.

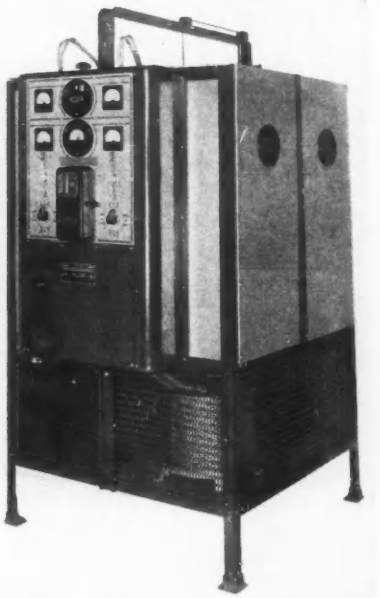
Scholler Bros., Inc., manufacturers of textile soaps, softeners, oils and finishes, have announced that Dr. Edwin C. Dreby III has become a member of their research staff.

Dr. Dreby is a graduate of the University of Pennsylvania with a B. S. in chemical engineering and also received his Ph.D. in physical chemistry at Yale University. He was associated with the National Bureau of Standards for several years as a research associate in the testing of textile finishes and, in addition, is the author of various articles published in the bulletins of the National Bureau of Standards and of the American Society for Testing Materials.

It is anticipated that the addition of Dr. Dreby to the staff of Scholler Bros., Inc., will be of real assistance and great value to the textile trades which they have served since 1907.

• ATLAS WEATHER-OMETER

Since the inauguration of the priorities system, manufacturers in all lines of business have experienced the uneasy feeling brought on by the necessity of using substitute materials. According to C. W. Jameson, president of Atlas Electric Devices Co. of Chicago, this situation has created a greatly increased demand for the New Atlas Twin-Arc Weather-Ometer. This machine is said to provide a dependable and accurate instrument of determining, within a few weeks, the result of months of weathering on products intended for outdoor use. Thus, a manufacturer of paints, varnishes, roofing material, and similar products can check the influence of weathering of his specimens and evaluate the quality or resilience of his new compounds, without losing valuable time.



Twin-Arc Weather-Ometer

The New Twin-Arc Weather-Ometer is said to faithfully duplicate the action of outdoor weathering by combining the action of June sunlight, rain, heavy dew,

and thermal shock. It is reported to be a distinct improvement over previous models and was developed especially for those whose needs call for even more greatly accelerated test results. This increase in speed and efficiency over previously available equipment is said to be accomplished by the increase of active light at the specimen and the co-ordination of thermal shocks produced by cold water spray. The instrument is equipped with a robot cycle meter governing the light and thermal shock periods automatically. The cycle can be modified for various materials such as bitumens, paint, lacquer, varnish, plastics, fabrics, rubber, etc. So automatic is this machine that the manufacturers state that no operator attention is required other than inspection of samples and reloading of the arc units once in each 24 hours.

Strong claims are also made for the economical operation of the New Twin-Arc Weather-Ometer as the total cost of carbon and current consumption amounts to only $1.20 for a 24-hour day. Of interest is the announcement that all standard Weather-Ometers now in use can be converted economically into the New Twin-Arc Testing Unit. Full details can be obtained by contacting the Atlas Electric Devices Co 397 West Superior St., Chicago, Ill.

● PORTABLE COLORIMETER

A new Photoelectric Colorimeter is being announced by Photovolt Corporation, 95 Madison Avenue, New York City, manufacturers of the Lumetron line of Photoelectric Colorimeters and Fluorescence Meters.

The Lumetron Mod. 400 is said to feature portability, simplicity of operation and low price. It is built into a wooden housing with cover and carrying strap, so as to be used in the laboratory as well as in the plant. It works from any AC or DC, 110 Volt outlet and is claimed to be exceedingly simple in operation.

It is claimed that, while being in the price range of visual colorimeters, Lumetron Mod. 400 offers all the advantages of the photoelectric instrument over the visual comparison instrument. The readings are said to be definite and independent of the judgment of the operator, and no standard solutions are required at any time in routine work.

● SUNK BY ENEMY ACTION

A carload of cotton softener, shipped by The Hart Products Corp., and consigned to a southern mill was lost when the S. S. City of Atlanta, bound for Savannah, was sunk by enemy action, January 19, 1942.

● COLOR PROGRAM

The woolen, silk and millinery committees of The Textile Color Card Association, together with its recently formed dyestuffs advisory committee, have just held a joint meeting, it was announced recently by Margaret Hayden Rorke, Managing Director, to discuss the organization's color program for the 1942 Fall and future seasons, so that the shades chosen by these various groups will not interfere with the Government's war program by drawing too heavily on dyestuff materials required for national defense.

While it was the consensus of the meeting that the number of colors in all collections be reduced, it was stressed nevertheless that color acted not only as a powerful merchandising and fashion stimulant, but served also as an important factor in uplifting public morale. It was felt, therefore, that color should be promoted with confidence and as a patriotic duty, but at the same time, in accordance with a carefully planned program of presenting to the consumer only those shades which do not conflict with the nation's war needs. In establishing such a policy, the Association believes it will go far in assisting the textile and allied industries, as well as the Government. The committee on dyestuffs, Mrs. Rorke stated, will act as an advisory group to the Association's various color committees, including those for shoes and leather, gloves, hosiery, fabrics and millinery.

Mrs. Rorke further announced that she had enlisted the cooperation of leading rayon firms in selecting a suitable basic type of fabric as a substitute for silk, which, since the founding of the Association in 1915, has been used to portray the colors in the silk card. At this joint meeting, a new fabric was adopted, which will be used in the 1942 Fall Rayon Color Card.

● 1942 SPRING HOSIERY CARD

The regular edition of the 1942 Spring Hosiery Card has just been released to the trade by The Textile Color Card Association, it was announced recently. As previously noted, when the Confidential Advance Hosiery Card was issued to members, the number of colors has been reduced to four, in the interests of the national war effort.

The Spring 1942 hosiery shades comprise: *Blushblood,* skin tone; *Sunnitan,* a sun tone; *Amberspice,* burnt shade; *Townmist,* a neutral beige. The card is issued in cooperation with the National Association of Hosiery Manufacturers.

● SULFAMIC ACID

Sulfamic acid, available since November in tonnage quantities, is expected to be widely used to remove excess nitrite in dye and colored pigment manufacture, the American Chemical Society symposium at Columbus, Ohio, on December 29, was told by Drs. M. E. Cupery and W. E. Gordon of the Du Pont Company.

Describing the industrial uses for sulfamic acid which have been worked out since an economical method of making the crystalline solid was discovered about three years ago, the chemists emphasized that the first important industrial application was based on the exceedingly rapid and quantitative reaction of sulfamic acid with nitrous acid.

"In a representative pigment manufacturing process, which originally required 25 pounds of urea and a period of three hours to complete the excess nitrite removal," said Dr. Cupery, "four pounds of sulfamic acid now complete the same reaction in about five minutes. Similar results are obtained in azo dye manufacture.

"In such procedures," he continued, "a larger excess of nitrite may frequently be used to facilitate diazotization. Because the reaction may be more closely controlled, cleaner shades of color with better uniformity in batches is possible.

"Moreover, in small package textile dye preparations, which may be purchased for home applications, a solid acid ingredient is often included in the package for fixing the dye at the end of the dyeing process. For such usage the acid must be crystalline, must not absorb moisture, and preferably form a strong acid when dissolved in water. Sulfamic acid meets these requirements."

It is stated that, since sulfamic acid will not absorb water in storage and can be safely handled, and because tonnage production at a new plant at Grasselli, N. J., has brought price decreases ranging up to 50 per cent, it is expected that its industrial importance will grow rapidly.

● APPOINTED VICE-CHAIRMAN

Charles P. Gulick, President and Chairman of the Board, National Oil Products Co., has recently been appointed Vice-Chairman in Charge of the West Hudson Industrial Committee in the $50,000,000 American Red Cross War Fund Drive.

● WARNER CHEMICAL EXPANDS OFFICES

To increase its facilities for serving chemical consumers in the Middle West, the Warner Chemical Company has expanded its Chicago office and now occupies new quarters in the Board of Trade Building, 141 West Jackson Boulevard. The telephone number is Wabash 7554. W. Newell Wyatt is the Divisional Sales Manager in charge of the middle-western territory, not only for the Warner Chemical Company, but also for the California Chemical Company and the Magnesol Company, all of these companies being divisions of the Westvaco Chlorine Products Corporation.

● SUBCONTRACTING FOR DEFENSE

"Subcontracting for Defense: A study Prepared in the Interest of Stabilizing Em-

ployment," is a report just issued by the Policyholders Service Bureau of the Metropolitan Life Insurance Company. This study outlines the methods followed by 28 companies that have been outstandingly successful in meeting the problems of prime contracting or subcontracting. It includes a section on obtaining prime contracts for various types of supplies and equipment required by the Government; describes sources of information on Governmental requirements and on procurement setup and procedure. It discusses the administration of and responsibility for subcontracting in the prime contractor's organization, and steps commonly followed in selecting and scheduling work to be farmed out. The report also shows a variety of sources which primary contractors use to locate and contact subcontractors, and methods adopted for appraising their facilities and skill.

The procedure followed in obtaining a subcontract is thoroughly covered in the report by a presentation of details of the methods used by successful subcontractors. Some of the other points are: the assistance typically given by the prime contractor to the subcontractor, production control procedures for both the prime contractor and the subcontractor, and the basis for pricing subcontract work. The study includes a number of practical charts and diagrams illustrating methods and procedures successfully used by contributors to the survey.

A copy of this report is available to executives who request it on their business stationery. Address: Policyholders Service Bureau, Metropolitan Life Insurance Company, One Madison Avenue, New York City.

● JOINS CAROLINA ANILINE

E. B. Simpson has joined the Carolina Aniline & Extract Company, Inc., in a technical and sales capacity and will make his headquarters at their main office in Charlotte, N. C. Mr. Simpson has had 30 years' plant experience in the bleaching and piece goods finishing business. His former connections include many years with the Millville Manufacturing Co., Millville, N. J., "Red Star Fabrics," Utica Willowvale Company, Chadwicks, N. Y.; Danvers Bleaching Division, Naumkeag Steam Cotton Mills, Salem, Mass., and also Bradford Dyers Association and Aspinook Company.

● ARNOLD, HOFFMAN SOUTHERN MANAGERS

Arnold, Hoffman & Company, with headquarters in Providence, has recently appointed Walter T. Bunce and W. Chester Cobb Managers of the Southern territory. This step was necessary since it is expected that Mr. Cobb, who is a Reserve First Lieutenant, will soon be called into the Service.

Mr. Cobb has been the Charlotte Manager for some time. Mr. Bunce was formerly manager of the Drysalters Division of the Hercules Powder Co., and came with Arnold, Hoffman & Company when they purchased the Drysalters Division last year.

● TEXTILE SCHOOL STYLE SHOW

Dr. Thomas Nelson, Dean of the Textile School at North Carolina State College, announced on February 3rd that ten North Carolina colleges for women had accepted the invitation of the Textile School to participate in the 15th annual Style Show which will be held at Raleigh on April 30.

Started in 1928 with the cooperation of Meredith College, the Style Show has developed until it is now one of the feature events of the year on the North Carolina State College campus, and the fabrics available include cotton, rayon, spun rayon, and combinations of wool and other fibers.

As a part of their regular classroom work in home economics, approximately 160 young women will design, make, and then model at the Style Show, costumes from fabrics designed and woven at North Carolina State College by Textile students.

This year the cooperating institutions are Appalachian State Teachers College, Elon College, Flora Macdonald College, Greensboro College, High Point College, Louisburg College, Meredith College, Peace Junior College, Queens College, and Saint Mary's School.

WOOL PROTEIN

(Continued from page 78)

amounts of non-ionized acid results in the combination of additional amounts of acid in the undissociated form as is found with weak acids generally[13].

The data at 0° C. include measurements with two acids, sulfuric and pyrophosphoric, which are diabasic in the pH range of their respective curves. The amounts combined are therefore plotted as milliequivalents per gram instead of millimoles per gram. The curves for both indicate that their doubly charged anions have relatively high affinities, considering their molecular weights. A part at least of their high affinity may be due to the double charge, but this cannot constitute a full explanation. Thus, pyrophosphate has a lower affinity than sulfate although its molecular weight is considerably higher.

The curve obtained with metaphosphoric acid is not strictly comparable with those obtained with the other acids, because of the presence of chloride, divalent monohydrogen trimetaphosphate, and trivalent metaphosphate ions. Its position is probably determined predominantly by the affinity of the divalent ion (or its dimer), since the concentration of this acid ion increases almost proportionally to the increase in hydrogen ion, as is the case when curves are obtained with strong acids in the absence of salt. The higher affinity of the basic trimetaphosphate ion is probably indicated by the titration curves obtained by Briggs for the soluble protein, serum albumen[2]. Because the titration-curves for soluble proteins fall in a region of higher pH values[12] in these experiments the metaphosphate is nearly all in the fully ionized form. Thus the difference between the curves obtained by Briggs with hydrochloric acid and with hydrochloric acid plus metaphosphate is much larger than the difference found here with wool.

Among the data given for 25° C. are measurements made with a third divalent anion, sulfosalicylate, commonly used as a protein precipitant. The affinity, as would be expected, is high but not as high as that of two other protein precipitants of higher molecular weight, picric and flavianic acids[16]. As in the case of flavianic acid, amounts far in excess of 0.8 *millicquivalents* per g. are bound at low pH values. The anion present in this region of pH is the monovalent ion, and a plateau near 0.8 *millimole* rather than at 0.8 milliequivalent would presumably be found.

The results shown for octylsulfuric, dodecylsulfonic and dodecylsulfuric acids are the first given for strong aliphatic acids of high molecular weight. The first of these has a molecular weight slightly above that of naphthalenesulfonic acid; its affinity for wool is obviously

higher. The affinities of the two larger molecules are among the highest so far measured.* These results tend to contradict a suggestion made earlier[16], namely, that flat aromatic ions had higher affinities than linear ions, and are therefore discussed further elsewhere.

Among the data obtained at 50° C. (Fig. 2), the new

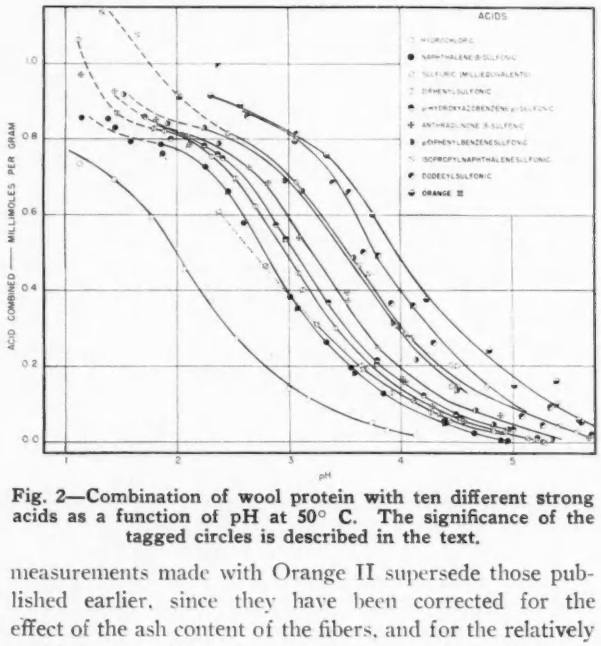


Fig. 2—Combination of wool protein with ten different strong acids as a function of pH at 50° C. The significance of the tagged circles is described in the text.

measurements made with Orange II supersede those published earlier, since they have been corrected for the effect of the ash content of the fibers, and for the relatively rapid decomposition of the wool that occurs in the more concentrated solutions of this dye. The results therefore differ slightly from those published earlier.

With sulfuric acid the data at 50° C. are much like those obtained at 0° C. when the amounts combined are less than 0.3 milliequivalents per gram; beyond this point the increase in the amounts combined as the pH decreases is smaller than at the lower temperature. This anomaly may be attributed to the formation in the more acid solutions of the low-affinity *bisulfate* ion, a process which is enhanced by high temperature (the second dissociation constant of sulfuric acid decreases as the temperature is raised[4]). Thus at pH values below 3 there is considerably more bisulfate ion at 50° C. than at 25° C. This effect of high temperatures in effectually diminishing the affinity of sulfuric acid is of importance in dyeing where not only high temperature but the presence of sulfate in addition to sulfuric acid favors the formation of bisulfate ion.

2. The Scale of Anion Affinities

In order to compare the results obtained with different acids on other than an empirical basis, it is necessary to reduce the positions of the curves to corresponding values of K_A', the anion dissociation constant, defined in previous papers[12, 16]. The resulting series of constants, calculated from the pH values at which half the maximum amounts are combined, not only furnishes an affinity scale to which a quantitative significance can be attached, but also makes possible the calculation of the effects of other environmental factors, such as the presence of salts, in terms of a mass action effect, or of the effect of temperature, in terms of heats of dissociation. A slight modification[11] in the original method of calculation has recently been introduced in order to extend the range of usefulness of the previously formulated equations. With this modification, the equa-

TABLE I
Calculation of Anion Affinity Constants ($1/K_A'$)

	Molecular wt.	*pH of half maximum combination*	*$-\log K_A'$*	*$-\log K_A'$ previously given*
	0° C.			
Phosphoric	98.0	2.155	0.115	....
Sulfamic	97.1	2.22	0.20	....
Hydrochloric	36.5	2.32	0.43	0.45
Ethylsulfuric	126.1	2.33	0.44	0.45
Hydrobromic	80.9	2.47	0.69	0.74
Nitric	63.0	2.58	0.89	0.96
Iso-Amylsulfonic	152.2	2.58	0.89	....
Benzenesulfonic	158.2	2.63	1.00	1.05
p-Toluenesulfonic	172.2	2.66	1.035	1.10
o-Phenolsulfonic	174.2	2.66	1.035	....
o-Xylene-*p*-sulfonic	186.2	2.71	1.12	1.21
[a]Metaphosphoric	$(80.0)_n$	2.72	[a](1.14)	....
Trichloroacetic	163.4	2.73	1.16	1.25
o-Nitrobenzenesulfonic	203.2	2.86	1.39	1.50
[b]Pyrophosphoric	178.0	2.94	1.53	....
4-Nitrochlorobenzene-2-sulfonic	237.6	3.07	1.76	1.93
[b]Sulfuric	98.1	3.08	1.78	....
2, 5-dichlorobenzene-sulfonic	227.1	3.13	1.87	1.95
2, 4-Dinitrobenzenesulfonic	248.2	3.17	1.94	2.09
Naphthalene-β-sulfonic	208.2	3.24	2.06	2.23
2, 4, 6-Trinitroresorcinol	245.1	3.64	2.73	3.02
Picric	229.1	3.86	3.08	3.34
Flavianic[b, c]	314.2	4.24	3.67	3.94
	25° C.			
Hydrochloric	36.5	2.16	0.265	0.31
Naphthalene-β-sulfonic	208.2	3.03	1.82	1.97
Octylsulfuric	210.3	3.47	2.56	
Sulfosalicylic	218.1	3.34	2.34	
Picric	229.1	3.52	2.64	2.89
Dodecylsulfuric	266.4	4.02	3.42	
Flavianic[b]	314.2	4.07	3.495	3.77
Dodecylsulfonic[e]	250.4	4.08	3.51	
Orange II[e]	328.3	4.63[e]	4.28[e]	4.53[e]
	50° C.			
Hydrochloric	36.5	2.17	0.28	0.38
Naphthalene-β-sulfonic	208.2	2.95	1.68	
Sulfuric[b]	98.1	2.97[d]	1.71	
Diphenylsulfonic	234.3	3.16	2.04	
p-Hydroxyazobenzene-*p*'-sulfonic	278.3	3.24	2.18	
Anthraquinone-β-sulfonic	288.3	3.40	2.44	
p-Diphenylbenzenesulfonic	310.4	3.70	2.93	
iso-Propylnaphthalenesulfonic	250.3	3.74	2.99	
Dodecylsulfonic	250.4	3.96	3.33	
Orange II	328.3	4.17	3.64	†3.94

[a]The affinity indicated is minimal, for reasons explained in the text.
[b]The data given refer to combination with the divalent anion, but K_A' is expressed, for purposes of comparison, as if the anion were monovalent.
[c]The affinity given is minimal because equilibrium may not have been attained.
[d]Extrapolated from the lower (normal) portion of the titration-curve. The actual midpoint pH was 2.92.
[e]The midpoint pH of the curve obtained with Orange II at 25° C. has been re-evaluated by applying a correction for ash to these data. Both values of $-\log K_A'$ are based on the re-evaluated midpoint.
†This value is based on the revised pH given in the present paper.

*The high affinity of dodecylsulfate is of special interest in view of its recent use as a protein denaturant'. As Smith[8] has shown, the effect of this substance, unlike that of other protein denaturants, is to disrupt at least one protein into fragments. The hydrolytic effect of dodecylsulfuric acid on wool protein, described elsewhere[17], is the greatest of any acid so far investigated. Since, in general, the hydrolytic effect increases with the affinity, the drastic effects of dodecylsulfate on soluble proteins may be shared in greater or lesser degree by other high molecular weight compounds.

tions describe the relevant parts of the curves in full detail, and not merely the positions of the midpoints of the curves.

Using the new equations, values of K_A' for all the acids so far investigated have been calculated employing the appropriate values of K_H' for each temperature[16]. The results of the calculation are assembled in Table 1. The newly calculated values of $-\log K_A'$ for acids measured previously are compared in the table with the values given earlier. The revised values are not far different from those given by the old equations, especially in the range of lower affinities. The larger differences are found with the anions of highest affinity since there is a slightly smaller degree of dependence of K_A' on the pH of half maximum combination in the new equations.

3. The Effect of Temperature on Affinity

The revised values of K_A' in Table 1 entail a slight revision of the values previously given for $\triangle H$, the heat of dissociation of the anions from the anion-wool complex.

The assumptions which enter into calculations at two temperatures, for the dissociation of a hydrogen ion from the protein of $\triangle H$, from titration-data have been defined and discussed elsewhere[15] (especially p. 535 and footnote 11). The same assumptions are now applied to the calculation of the heat of dissociation of anions as well.

The new values are indicated in Table 2; it will be seen

TABLE II
Calculation of Heats of Dissociation of Anion-Wool Combinations

Anion	*Temperature interval*	*Ratio of dissociation constants*	ΔH *(average heat of dissociation)*
	0° C.		
			calories
Chloride	0—25	1.481	2550
	25—50	0.975	—194
Sulfate	0—50	1.163	532
Naphthalene-β-sulfonate	0—25	1.755	3640
	25—50	1.338	2220
Picrate	0—25	2.75	6550
Dodecylsulfonate	25—50	1.51	3180
Orange II	25—50	>4.36	>11,300

that they are not greatly altered from those given previously. With one exception, they extend and confirm the regularity described earlier, namely, a pronounced tendency for the average heat of dissociation in a given temperature interval to increase as the affinity increases. The relatively small value for sulfate ion, which constitutes the exception noted, must be accepted with reservations on two counts: first, the affinity constants from which it has been calculated have only formal significance since they apply strictly only to monovalent anions. In addition, the value given for $\triangle H$ for this acid, unlike all others in the table, is an average value over the wide temperature interval 0° C.-50° C. A comparison with the results obtained with hydrochloric acid suggests that the heat of dissociation of sulfate from the sulfate-wool complex may be approximately twice as great in the 0° C.-25° C. interval as the average value given in the table for the wider range.

IV. THE RELATION OF CHEMICAL STRUCTURE TO AFFINITY

The data collected in Table 1 reveal a pronounced tendency for the affinity of anions for wool to rise with their molecular weights. Thus, the question of the existence of any additional factors modifying this tendency may best be examined by comparing the affinities of different substances or classes of substances on the basis of their sizes or molecular weights rather than by comparing the affinities themselves. Such a comparison is facilitated by Figure 3, in which quantities proportional

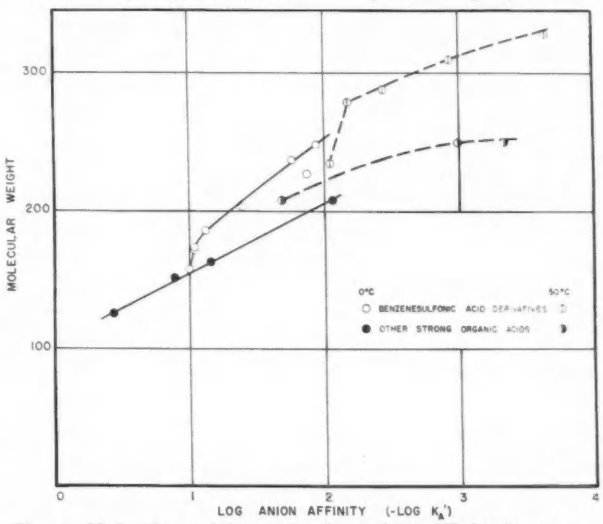


Fig. 3—Molecular weights and values of log affinity for strong monobasic organic acids. Data for two temperatures, 0° C. and 50° C., are represented.

to the free energy of binding of the anions ($-\log K_A'$) of a large proportion of all the acids studied have been plotted against their respective molecular weights. Among the acids investigated only the strong monobasic organic acids are represented in order to bring out simple relationships more clearly. To include as wide a range of molecular weights and of affinities as possible, data for two temperatures, 0° C. and 50° C., have been combined; a division between the data at the two temperatures has been effected arbitrarily with only slight overlapping, at $\log K_A'$ approximately equal to —2. Naturally it cannot be expected that there will be any continuity between the data obtained at the two different temperatures, but their combination serves to point a trend, and the data for each temperature may be compared among themselves.

The simple relations shown indicate an absence of any large specific effects of different substituents on the affinity within the two groups of acids represented. Thus, to point to only a few examples, *o*-phenolsulfonic and *p*-toluenesulfonic acids have nearly equal molecular weights and show practically identical affinities, although the properties of the OH and CH_3 groups (such as polarity, polarizeability, and resonance energy) differ markedly. Likewise the differences in the positions on the diagram of xylene-, nitro-benzene, nitrochloro-benzene, and dinitrobenzenesulfonic acids are consistent with their rela-

tive molecular weights, despite similar large differences in the properties of their respective substituents. Such regularities in the relation between affinity and molecular weight as are shown in Fig. 3 imply that the effects of temperature on anion affinity are also fairly regular. This has already been indicated by the data presented in the preceding section.

However, the fact that the points in the diagram fall roughly into two groups is an indication that there are limits to the range of chemical structure within which marked specific effects fail to appear. Thus, among strong organic acids, those which are benzenoid in character have lower affinities for wool than those which fall in other categories (aliphatic, naphthenoid, etc.). Since the simplest member of the benzenoid series, benzenesulfonic acid, falls on both curves, it cannot be maintained that the benzene ring itself has a particularly low ratio of affinity to mass. Rather, it appears that the mass added by a substituent to the benzene ring is relatively less effective in increasing the affinity to wool, than is the same mass added to aliphatic or conjugated ring compounds. This reduced effectiveness appears even when the substituent added is another benzene ring, as is shown in the strictly homologous series benzenesulfonic, diphenylsulfonic, diphenylbenzenesulfonic acids. It does not appear, or appears less strongly, when the rings are conjugated, as in naphthalenesulfonic acid. The existence of similar effects is suggested by the scantier data obtained at 25° C., which are not represented in the figure. The reason for these differences remains obscure.

If the affinities of other types of acids were included in Fig. 3, the existence of marked specific differences in affinity would be well shown. Thus points for the two strong phenolic acids, picric acid and trinitroresorcinol would fall well below the curve for the benzenesulfonic acid derivatives; i.e., these phenolic acids have relatively high ratios of affinity to mass, when compared with other benzenoid compounds. As would be expected, doubly charged anions, such as flavianate and sulfosalicylate also have higher ratios of affinity to mass. The greatest specific differences appear among the inorganic acids, the points for which, if included in the figure, would scatter widely in its lower left-hand corner. Although all their affinities fall in the lower part of the range covered, all but sulfamic and the two phosphoric acids have relatively higher ratios of affinity to mass than do any of the organic acids. The common acids, hydrochloric, nitric, and sulfuric are outstanding in this respect.

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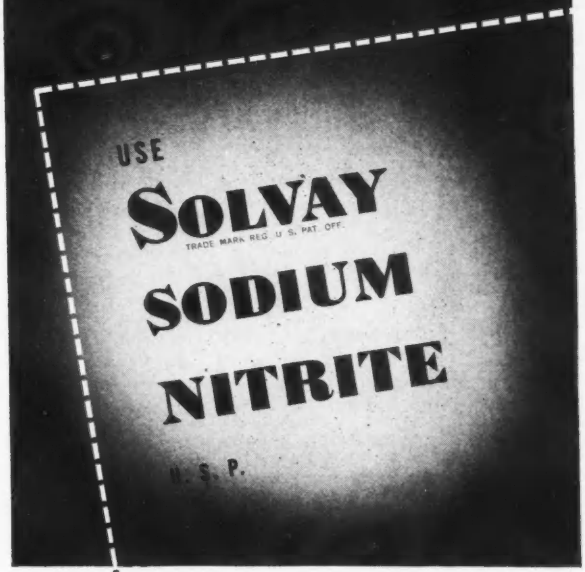

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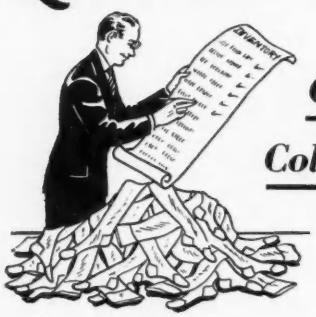

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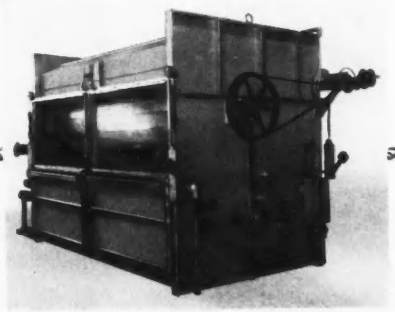

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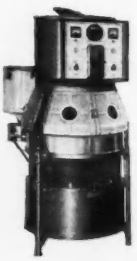
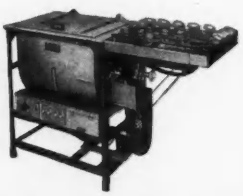


ATLAS FADE-OMETER is accepted as the standard testing instrument for predetermining light fastness of textiles and colors. Should be used in complying with Federal and A.A.T.C.C. specifications.



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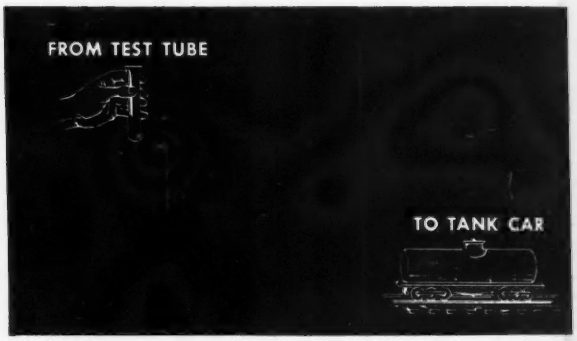

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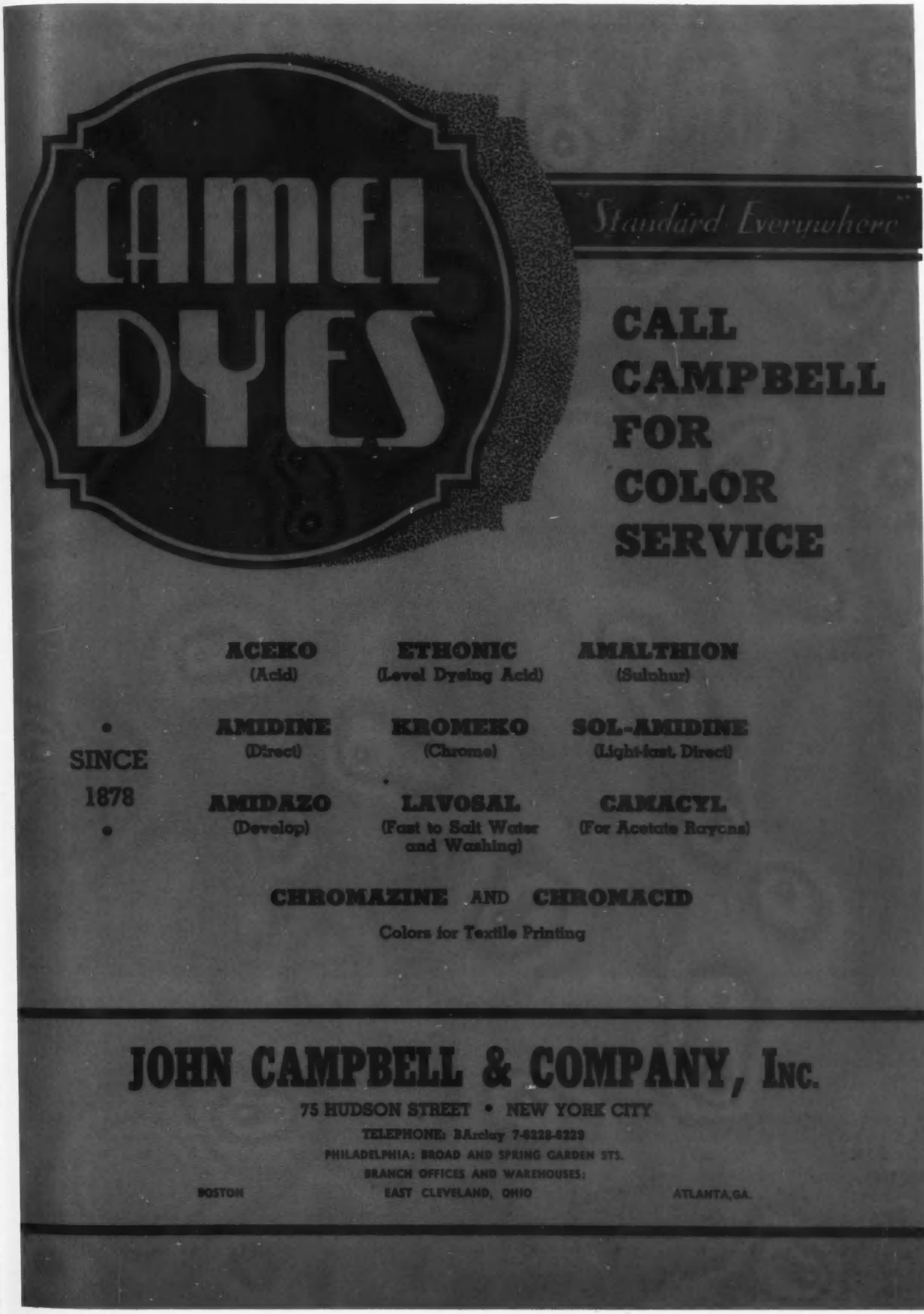
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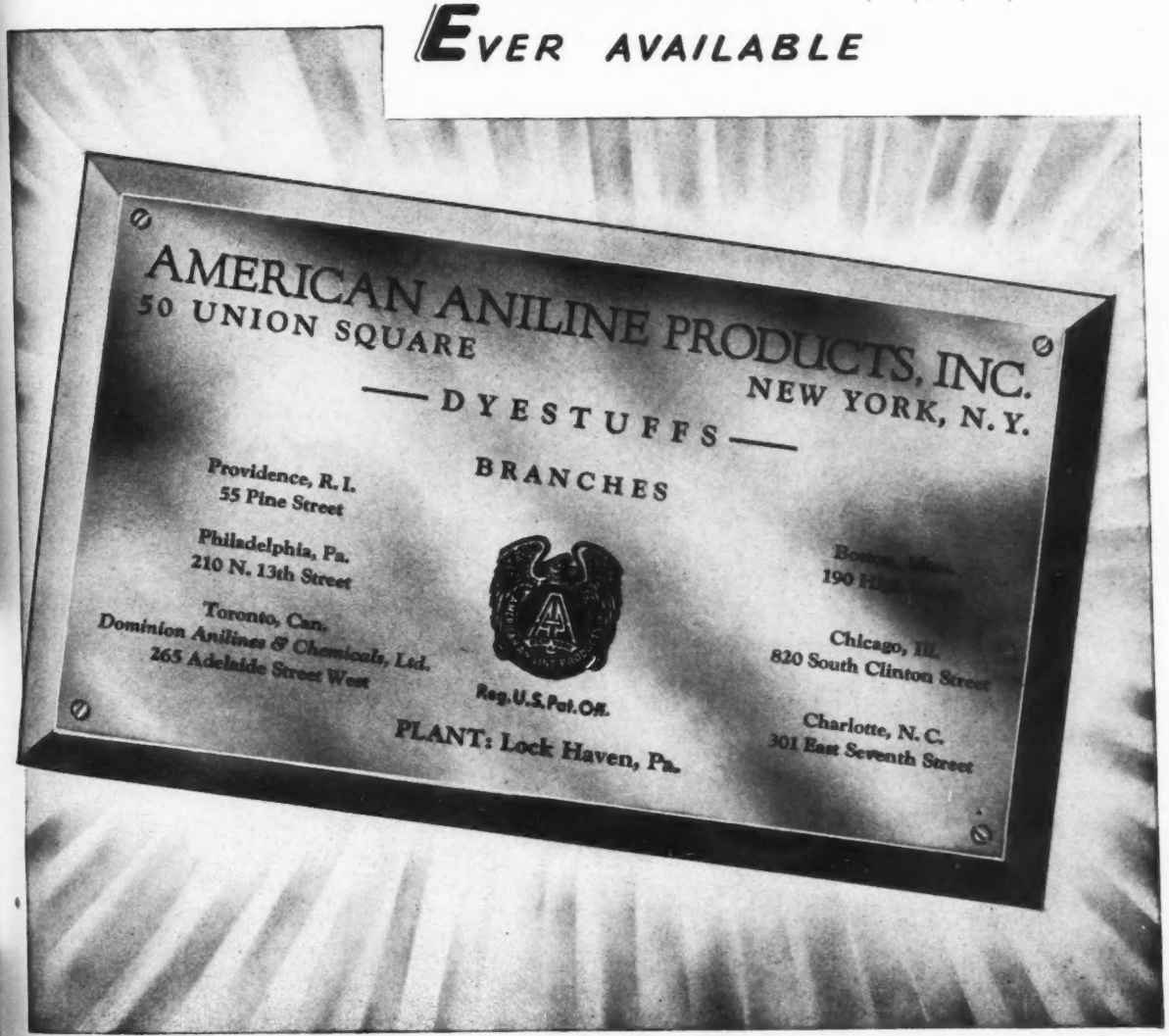

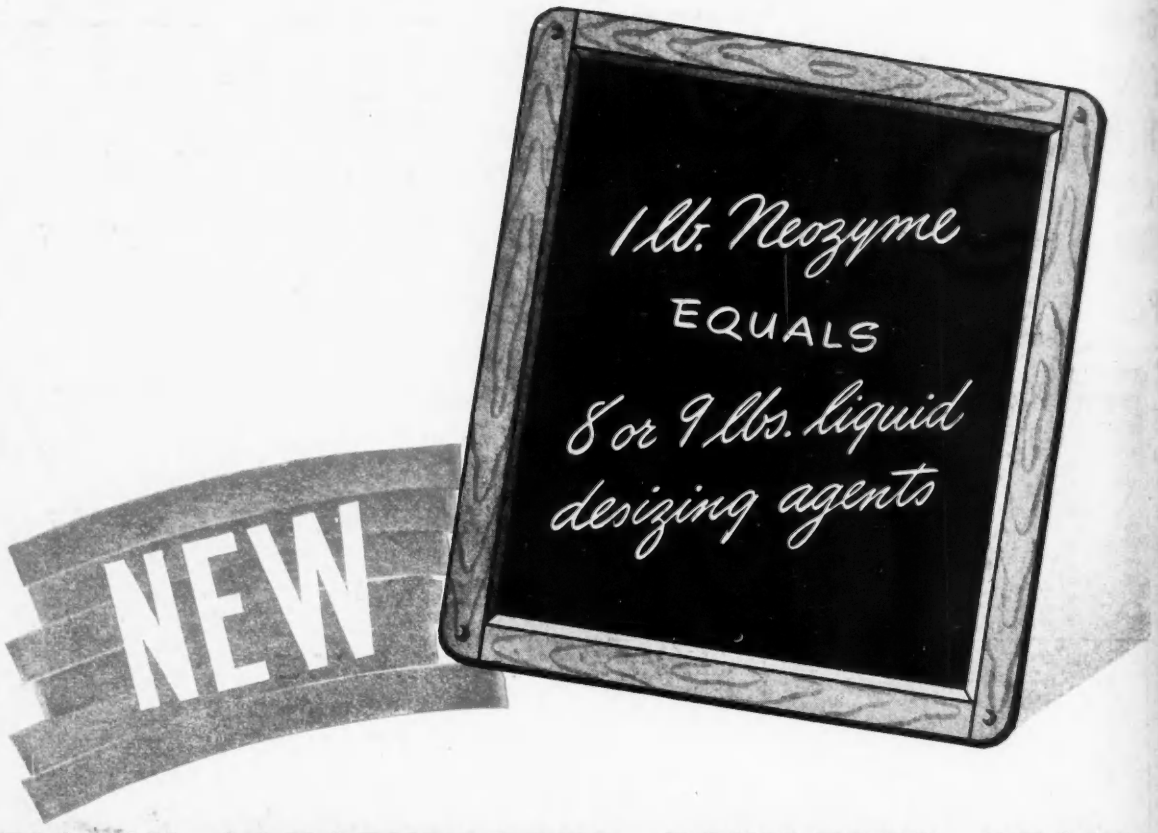

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